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ECOLOGICAL INTERPRETATIONS OF THE WHITE CAP DRAINAGE:

A BASIS FOR WILDERNESS FIRE MANAGEMENT

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REVIEW DRAFT

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ECOLOGICAL INTERPRETATIONS OF THE WHITE CAP DRAINAGE: A BASIS FOR WILDERNESS FIRE MANAGEMENT

SUMMARY STATEMENT

Presented to Chief and Staff
August 1972

by

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and
Robert W. Mutch, Research Forester, Intermountain Station

Fire management direction in Region One since 1970 has called for a more natural incidence of fire in wilderness. This recognition of the role of fire in wilderness management is in harmony with the 1964 Wilderness Act and the recent policy review that recommended the perpetuation of unmodified ecosystems in wilderness. The White Cap Wilderness Fire Management Study was started in the Selway-Bitterroot Wilderness, Bitterroot National Forest, in August 1970, to:

1. Develop inventory methods that relate fire management to the wilderness resource.

2. Determine relationships between fire and wilderness ecosystems.

3. Determine strategies for a more natural incidence of fire in wilderness.

This adminstrative study, funded by the Washington Office Division of Fire Control, is a cooperative effort between National Forest Systems, Research, and the University of Montana. The purpose of the study is to provide a defensible planning basis for preparing fire management prescriptions in wilderness. The 1971 Denver Fire Policy Meeting authorized preplanned exceptions to 10 a.m. fire control policy subject to approval by Regional Forester and Chief.

The above stated study objectives require understanding of relationships between fire and vegetation diversity, the effects of successional development on flammability of plant communities, the effects of past fire control practices on plant communities and fuels, and the effects of continued fire suppression on wilderness ecosystems. Following 50 years of fire suppression, strategies to return fire to wilderness ecosystems must be based on an understanding of time-dependent relationships between forest productivity and flammability. Specific areas of study within the 100-square-mile White Cap Drainage include fire history, fuel inventory and appraisal, plant community dynamics, landform/soils, hydrology, and fisheries.

Study results to date have led to the combination of 18 land types and 10 habitat types into five ecological land units: (1) shrubfield, (2) ponderosa pine savanna, (3) ponderosa pine/Douglas-fir, (4) north slope communities, and (5) subalpine. The ecological land units are the basic units for implementing fire management prescriptions. Ecological land units are recognizable subdivisions of the landscape which are ecologically equivalent in terms of topography, vegetation, fuels, and fire potential. There are consistent similarities within these units and significant differences between units. An example of the ponderosa pine/Douglas-fir unit follows:

Ponderosa pine/Douglas-fir Fire Management Zone

1. Area: 10 percent

2. Landforms:

   a. Breakland type

   b. Cryoplanated type

3. Soils: Shallow, very permeable, coarse, single-grained sand

4. Habitat types, fuels, fire potential:

Habitat type	>4" Fuel	Duff	Spread	Intensity
	Tons/acre	Tons/acre	Ft./min.	B.t.u./ft.^{2} /min.
Douglas-fir/ninebark	10	13	10	2,920
Grand fir/pachistima	19	29	14	2,560
Ponderosa pine/Idaho fescue	0	1+	17	1,610
Douglas-fir/snowberry	0	9	5	2,077

5. Fire interval range: 1 year to 28 years

Study results have provided a valid basis for preparing fire management prescriptions for each ecological land unit (or fire management zone). Because the administrative study will terminate on June 30, 1973, we are requesting approval of the White Cap Fire Management Plan during the current fire season. On-the-ground experience with the fire management plan is an important phase of the study process.

Recognition must also be given to establishing a continuity of effort to fire management planning throughout the Wilderness Preservation System. The White Cap Study is one step toward perpetuating unmodified ecosystems in wilderness--much work remains to be done. The wilderness management job ahead of us is significant to a variety of groups: the Forest Service, the National Park Service, interested citizenry. There is a need to work closely with all of society to gain understanding and appreciation of the natural forces which shape the variety of landscapes we enjoy. The scientific aspects of wilderness also take on deeper meaning as we do more and more manipulating of land and vegetation across the country. There is much merit in the idea of truly dedicating certain areas to the perpetuation of naturally evolving plant and animal communities. Such communities may one day provide us with the vital links toward a better understanding of food chains, nutrient cycling, and energy flow; and help to indicate the management constraints that should be applied on all wildlands to maintain the viability of biological systems. Present day wildernesses might then have indirect benefits to all of society in the future--benefits even to those who may never have the opportunity to personally experience the character of wilderness.

WILDERNESS FIRE MANAGEMENT PLAN

Management Zone	Suppression	Observation	Observation + Suppression
1. Shrubfield	a. Hunting season: BUI >170 b. Along study boundaries	a. Prehunting season b. Hunting season: BUI <170	Fires approaching Wapiti Creek Ridge
2. Ponderosa pine savanna		a. BUI <170	BUI >170
3. Ponderosa pine/Douglas-fir	a. <4,500' elevation	a. >4,500' elevation BUI <170	>4,500', BUI >170
4. North slope	a. Along study boundaries b. BUI >170: Peach Creek Drainage	a. West of Peach Creek Drainage b. Upper White Cap unit	BUI >170; fires approaching Peach Creek buffer
5. Subalpine	a. Along study boundaries b. BUI >170: Bitterroot Crest passes	a. Season-long	BUI >170: fires approaching Bitterroot Crest passes

FIRE MANAGEMENT PRESCRIPTIONS FOR WHITE CAP CREEK
WILDERNESS FIRE MANAGEMENT STUDY AREA

Bitterroot National Forest
Region One

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Prepared by: Robert W. Mutch Northern Fire Laboratory Date 6/72

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Reviewed & approved by Date
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Date

Date

Date

Recommended by: Lawrence M. Whitfield Date 7/25/72
For Regional Forester

Reviewed by: Date

Date

Date

Date

Approved by: /s/ John R. McGuire Date 8/17/72
Chief

ABSTRACT

In 1970, Region One established management direction that fire will be allowed to play a more natural role in wilderness. This concept recognizes fire as an element of wilderness environments; and that perpetuating areas that are "untrammeled by man" and that appear to be "affected primarily by the forces of nature," as specified in the Wilderness Act, requires a more natural incidence of fire. The White Cap Wilderness Fire Management Study was established in 1970 in the Selway-Bitterroot Wilderness to investigate the role of fire in wilderness and to describe inventories and procedures needed to prepare fire management prescriptions. Specific areas of study were landform/soils, hydrology, fire history, plant community composition and structure, fuel inventory appraisal, fire potential, and fisheries. These data were utilized to describe five units in the study area that are ecologically equivalent in terms of topographic features, vegetation, fuels, and fire, and proposes fire management prescriptions for them. The five ecological land units, or fire management zones, are categorized as shrubfield, ponderosa pine savanna, ponderosa pine/Douglas-fir (south slope), north slope communities, and subalpine. The Fire Management Plan for the White Cap is specifically tailored to conditions within each of the ecological land units.

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PROLOGUE

> Western foresters have a highly developed fire phobia. In the last thirty years I have seen plenty of forest destruction by fire, but I have also come to realize what an essential part fire has played in the development of the stands of the three pines in Region One. We have failed to make any use of fire in our forestry, except in slash disposal.
>
> W. W. White, 1935

> Like W.W.W., I, too, have become pessimistic about ability to control fires. In 1919, I witnessed reproducing stands on 1889 burns licked up clean as a hound's tooth due to the intermingled accumulation of dead and rotten debris; in 1926, the beginning of the debacle in 1910 burns that could be expected when enough rotten fuels had accumulated to provide fire fodder, but not until 1934, when the Selway fires took the bit and walked away from all the organization and manpower that could be mustered, did I begin to lose faith in human ability to control any and all fires.
>
> Therefore, why not make fire our agent as well as our enemy. We have talked about it quite a lot, why not get under way?
>
> Roy A. Phillips, 1936

I. INTRODUCTORY PERSPECTIVE

And now we find ourselves, 36 years later, still trying to get underway. Many others have repeated the words of White and Phillips during the past 36 years. Why haven't we progressed further in our approaches to fire? Perhaps Bud Moore summed it up in his Selway-Bitterroot Wilderness notes in September 1971:

> Early Tuesday we contoured east to the old Bell Point trail and from the first vista overlooking East Moose Creek we spotted a small fire burning on a steep slope west of Footstool Point. Started by lightning, that little smoke was an obvious part of the natural scene. Since its opportunity to spawn a giant conflagration is small, as we live ...it should burn. And that certain life chains may thrive in wilderness...it should burn. Our pre- and post-season policy, if applied, would let it burn under surveillance. But I wonder, once discovered, if the adrenalin generated in men born of fire suppression will let that life-giving spark over there on the mountain give life.

Fire management was considered in the following historical account recorded in the Salmon Mountain District Fire Atlas, revised March 8, 1933:

> On July 24, 1927, a lightning fire occurred on Canyon Creek (one drainage south of White Cap Creek). The fire attained the size of about 11 acres, after burning for about three weeks. About two acres of the area crowned. When the men first arrived, the fire consisted of about a dozen small spots, ranging from 2 feet to 10 feet in diameter. It was entirely in slide rock and boulders too large to handle in constructing a fire trench. This slide rock was intermixed with duff, which ran from three to six feet deep, and was at this time very dry.
>
> The fire was at an altitude of about 7,000 feet on a north exposure slope averaging 80 percent.
>
> The reason why this fire became a class C is as follows: since there was no danger of the fire's getting away so as to do any particular damage, it was thought best to let it burn out more or less of its own accord, rather than to spend large sums in checking it where it was.

THE WILDERNESS ACT

The Wilderness Act of 1964 (see Appendix) gives clear conceptual directions for management of the National Wilderness Preservation System:

> An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;...

However, Special Provisions Sec. 4(3)(1) of the Act specify that "such measures may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable." So the wording of the Special Provisions does allow for a variety of approaches to fire. Expanding on the Special Provisions Section, Region One FSM 2324.2 states: "'Necessary' here is defined as needed for meeting the wilderness definition and for protecting life and property in the Wilderness or resources outside."

Generally, the Forest Service has provided complete fire control measures in wilderness, although there have been exceptions in Regions One and Three. Participants in Region One's Wilderness Workshop in Missoula in 1970 recognized that fire control as practiced today is an unnatural action in wilderness. This group contributed to a new Regional policy that "fire will be allowed to more nearly play its natural role" in wilderness.

The next document of interest is the Fire Policy Meeting in Denver in May 1970. One of the outcomes of this meeting is that deviations from the 10 a.m. control policy could be made in wilderness based on an approved fire management plan. The Fire Policy Meeting report, May 1971, indicated under Recommendation No. 1 that the Washington Office would rewrite fire control policy reaffirming 10 a.m. policy, but allowing for preplanned exceptions approved by the Chief. Regional Foresters, where appropriate, would analyze and prepare decision logic plans which clearly state criteria, conditions, and action to be taken in establishing exceptions to 10 a.m. policy. Provisions for monitoring, and line officer control of such

exceptions, will be made a part of all plans. Region One had previously recognized that implementing new fire management directions would require an approved plan and had initiated the Wilderness Fire Management Study in the Selway-Bitterroot in August 1970 (Aldrich and Mutch 1971). This study is being cooperatively supported by the Division of Fire Control, Washington, D. C.; Division of Fire Control, Missoula, Montana; and the Intermountain Forest and Range Experiment Station. Specific objectives of the study are to:

1. Develop inventory methods that relate fire management to the wilderness resource.

2. Determine relationships between fire and wilderness ecosystems.

3. Develop strategies (fire management plan) for a more natural incidence of fire in wilderness.

PURPOSE OF THIS REPORT

This report is intended to describe relationships among vegetation, fuels, fire, and wilderness ecosystems and to determine strategies to return fire to wilderness systems. The report applies to objectives 2 and 3 above. Objective 1 will be treated in another document. The purpose of this report is to establish the physical and biological framework of the White Cap Drainage from which strategies for a more natural incidence of fire in wilderness will be determined.

STUDY METHODS

The above-stated study objectives require understanding of relationships between fire and vegetation diversity, the effects of successional development on flammability of plant communities, the effects of past fire control practice on plant communities and fuels, and the effects of continued fire suppression on wilderness ecosystems. Following 50 years of fire suppression, strategies to return fire to wilderness ecosystems must be based on an understanding of time-dependent relationships between forest productivity and flammability. Specific areas of study within the 100-square-mile White Cap Drainage include fire history, fuel inventory and appraisal, plant community dynamics, landform/soils, hydrology, fisheries, and preattack planning.

The primary areas of study included fire history analysis, fuel inventory and appraisal, and plant community dynamics. Fire history, or an understanding of the range of fire frequencies in different environments, is a part of the information required to prepare a fire management plan. Fire history in the White Cap was determined from historical records, Forest Service records, increment borings, and cross-sectional wedges (from stands outside the Wilderness boundary).

The fuel inventory system[1/] was designed to provide quantitative fuel and vegetation data that will be used to appraise fire potential within different habitat types, timber types, or stands. The inventory

---

1/ Fuel inventory methods are completely described in "Fuel and Vegetation Inventory Procedures--White Cap Study," Study Plan by James K. Brown, 1971; and "1972 Field Instructions for Bitterroot and St. Joe National Forests," on file at the Northern Forest Fire Laboratory, Missoula, Montana.

procedures are compatible with and parallel to the Forest Service Stage II Stand Analysis Procedures. Several different sampling techniques are utilized because of the complexity of living and dead vegetation. Fuel data collected fit the requirements of a mathematical model for predicting fire spread (Rothermel 1972). This model provides estimates of fire spread and intensity for a variety of slope, wind, and fuel moisture conditions. In the White Cap Study, fire potential appraisals are stratified by habitat types and timber types.

Much of the interest in wilderness to date has been in terms of wilderness classification, candidate areas, and boundaries. However, there is a growing need to better understand the processes at work within wilderness boundaries so that the wilderness character of these lands can be perpetuated or restored. Ohmann and Ream (1971b) reported that "before scientific techniques are chosen to accomplish this goal for a wilderness it is important to establish a sound ecological foundation. A basic part of this foundation must be a quantitative knowledge of the structure and composition of the plant communities."

Vegetation sampling procedures and data summarization methods have been patterned after Ohmann and Ream (1971a). Quantitative community data will be collected using the plotless point-centered quarter method (Cottam and Curtis 1956). Twenty points will be sampled in each homogeneous unit of vegetation. Any combination of species displaying homogeneity over an area large enough to sample will be accepted for study. Homogeneity will be accounted for by locating individual stands on uniform topographic sites in terms of exposure, slope position, and substrate. The first point will be randomly located in each stand and subsequent

points will be systematically located at 60-foot intervals. Diameters and distance will be recorded for the nearest tree (more than 4 inches d.b.h.) and nearest sapling (1 to 4 inches d.b.h.) in each of the quadrants.

A meter-square quadrat was established in quadrant number 1 at each sampling point. Tree seedlings were counted and coverage estimated on each quadrat. Shrub and herbaceous species were identified and coverage estimated on each quadrat. Daubenmire's (1959) six cover classes were used for coverage estimates:

1	<5 percent
2	5 - 25 percent
3	25 - 50 percent
4	50 - 75 percent
5	75 - 95 percent
6	>95 percent

Litter depth and coverage were determined on each quadrat. Elk and deer pellet groups were recorded on each quadrat.

The following environmental data were recorded:

1. Card identification number
2. Stand number
3. Air photo number
4. Township, range, section, 1/4 section, 40
5. Crew leader and crew
6. Month, day, year
7. Elevation
8. Slope

9. Aspect

10. Position on slope

    1 = ridgetop 3 = midslope 5 = valley

    2 = upper 4 = lower

11. Landform

12. Insolation

13. Average stand age

A composite soil sample was collected from three locations in each stand. Soils in the White Cap are primarily single-grained sands with very little horizon development. Therefore, samples were taken from the surface 1 foot below organic material.

Habitat typing of the drainage was accomplished by reconnaissance methods (see map, Appendix).

Land types in the White Cap study area were identified on the basis of stereoscopic study of aerial photographs. Each landform has characteristic stream development features which permit its identification and delineation. Landtypes identified through this process have had a good correlation to soil and vegetation characteristics.

WILDERNESS FIRE MANAGEMENT STUDY

The area selected for the intensive study site is the White Cap Drainage on the Magruder Ranger District, Bitterroot National Forest (Township 30 N., Range 15-16 E., B.M.). This area has a variety of landscapes, including high mountain lakes, old burns, a major drainage, diverse plant communities, and 1919 burns. The White Cap Drainage generally runs east and west; tributaries run north and south. White Cap is a major stream and drains into the Selway River, a tributary of the Clearwater River.

The Selway-Bitterroot Wilderness was chosen as the study site because it is large enough to be indicative of true Wilderness. The White Cap Drainage was specifically selected because it represents a microcosm of a wide spectrum of wilderness values. The fire suppression history of the drainage was advantageous in terms of a wilderness fire study. Over a 45-year period, there have been 212 fires in the drainage (see Appendix, DeZell). Fifty-eight class "B" and larger fires burned 1,247 acres, for an average size of 21 acres. Fire suppression efforts have been effective, as 154 fires in the drainage were suppressed at 1/4 acre or less in size. For this reason, the White Cap provides an excellent outdoor laboratory for studying effects of fire suppression on fuels and community dynamics. (Since this fire management plan was approved in August 1972, one fire burned out naturally at less than 1/4 acre.)

Habeck (1972) reported that the White Cap Drainage appears to possess the basic features seen in numerous of the west-draining watersheds in the Selway-Bitterroot Wilderness. Much of the information obtained in the White Cap should have application to other areas in the Selway-Bitterroot and to other Wildernesses.

WILDERNESS IMPLICATIONS OF NORTHERN ROCKY MOUNTAIN FIRE HISTORY

Wellner's (1970) summary remarks of fire history are worth considering at this point:

> Historically, fires have repeatedly burned nearly every square foot of northern Rocky Mountain forests. Fire damage was especially severe during the 75 years following 1860, and much of this was due to promiscuous burning by whites. Prior to 1940, fire was second only to precipitation as the major factor shaping the character of forests in this region. Unlike the frequent periodic ground fires reported in other parts of the United States, fires in the northern Rocky Mountains generally were catastrophic, causing heavy damage to the burned stand. As a result, forest stands tend to be even-aged. Very limited areas of ponderosa pine and Douglas-fir ecosystems have burned periodically without destroying all the forest stand.
>
> Tree species vary greatly in resistance to fire; however, severe fires largely erase differences in resistance. Scattered old trees of fire resistant species--western larch, ponderosa pine, and Douglas-fir--have been able to survive fires in all of the ecosystems in which they occur.
>
> The major ecological effect of fire has been disruption of forest succession. As a result, seral species have been favored and climax forests are of limited extent. Certain species, including western larch, lodgepole pine, and western pine, largely owe their present occurrence in the region to past fires.
>
> Single burns in uncut forests reforested rapidly. However, fire bred fire and many single burns reburned. Multiple burns usually remained without tree cover for a long period of time. Fire protection has largely prevented multiple burns and hence has increased the area of forest cover. Multiple burns on erosive soil in steep country have resulted in serious soil erosion.

> The historic occurrence, damage characteristics, and consequences of wildfire must be considered in planning the very necessary use of fire in management of northern Rocky Mountain forests.

Habeck (1972) recently related wilderness fire management to vegetation in the Selway-Bitterroot Wilderness:

> Increasingly effective fire control during the past 40 years, even within the roadless portions of the Selway-Bitterroot Wilderness, has caused a shift away from the pristine vegetation patterns, and might have also been instrumental in creating features unwanted on a Wilderness landscape. Current research efforts by various fire ecologists in the Selway-Bitterroot Wilderness are now attempting to assess the environmental impact of this long period of fire control; measurement of fuel accumulations, if any, are being taken, compositional shifts in forest communities are being studied, and basic burning characteristics of Wilderness forest communities are being investigated. The objective of these efforts is to determine how fire might best be reintroduced to the Wilderness terrain in order to recapture the original primeval character, and to also reduce the possibility of abnormal fire affecting the long-protected forest vegetation.

Wellner (1970) has proposed that fires in the northern Rocky Mountains are generally catastrophic (implying high-intensity fires, crown fires, and large-size fires). Many statistics can be employed to support this position and the actuality of multiple burns. But to dwell entirely on the catastrophic concept inhibits our ability to understand the significance of smaller and lower-intensity fires on forest systems of the northern Rocky Mountains. Wellner reported that only "very limited areas of ponderosa pine and Douglas-fir ecosystems have burned periodically without destroying all the forest stand." However, an appreciation of the dynamics of fuel succession in northern Rocky Mountain stands may also account for a considerable incidence of small fire mosaics in

most forest systems. It has been determined in Douglas-fir habitat types in the White Cap Drainage that stand fire cycles (determined from fire scars) average 9 years, with a range from 1-year intervals to 20-year intervals. Another aspect that must be considered is the small fire mosaic that can result from the so-called catastrophic fire, as stands, pockets, stringers, ravines, etc., within the burned perimeter may remain unburned for a variety of reasons. A more complete discussion of the continuum of fire treatments in forest systems will be found in the summary of the role of fuel and fire in the ecological land unit section.

II. CLIMATE AND SOILS

CLIMATE

Relatively few data are available on climatic conditions in the Selway-Bitterroot Wilderness. This discussion is limited to the southern portion of the Selway-Bitterroot Wilderness east of the Selway River. It is based on information from the closest year-round weather station in Hamilton, Montana; Forest Service weather stations, and Soil Conservation Service snow courses in the area. The Forest Service weather stations record information only during the summer season (May 1 to October 31). Three of these stations are represented: Magruder Ranger Station at just over 4,000-foot elevation; Moose Creek Ranger Station, approximately 2,200 feet; and Hell's Half Acre Lookout, approximately 8,000 feet.

The climate of the southern portion of the Selway-Bitterroot Wilderness is strongly influenced by the Bitterroot Divide in the eastern portion of the area. Within a distance of about 15 miles, there is an elevational gradient of up to 7,000 - 8,000 feet. Moisture-laden air rising over these elevated land masses is cooled and releases increasing amounts of moisture. The upper west slopes and the slopes immediately east of the Divide receive significantly greater amounts of precipitation than the lower slopes to the west, and the slopes in the rain shadow on the east side of the Divide. Precipitation distribution can be characterized by considering the extremes from west to east. Along the Selway River, total annual precipitation amounts to between 20 and 30 inches. Of this total, less than half occurs as snow. The Bitterroot

Crest receives at least 100 inches total annual precipitation, of which approximately three-fourths is in the form of snow. On the west slope of the Bitterroot, annual precipitation decreases to about 12 inches in the valley bottom. Along the Selway River, the climate approaches semiarid. The climate above 8,500 feet can be described as subarctic.

Winters in the low elevations along the Selway are cold, but snow seldom covers the south slopes completely for any period of time. Winter rains occur commonly. Late spring and early summer are commonly wet (May-June) but July and August are usually dry and hot. Low elevation temperatures during July and August often are 85°F. with the hottest days in the 95° to 100°F. range. Relative humidity during these periods drops below 20 percent, but usually makes a good night recovery. During the last of September and through October, there are 70° to 80°F. daytime temperatures and 30° to 35°F. night temperatures. Another precipitation period generally begins during late October or early November with general frontal rains and some snow.

At the higher elevations, winters are long and cold. Extreme cold and high winds and heavy snowfall are characteristic. Ten-foot snowpacks are common with drifts persisting into late July on shaded sites. Summers are very short and are characterized by cool daytime temperatures with cold nights.

In steep draws above 4,500 feet, and on slopes above 6,500 feet, frost can occur at any season. Above 8,500 feet, the growing season is about 30 days. July and August are typically dry.

Prevailing winds in the area are from the southwest. The higher elevations experience more frequent winds and winds of higher velocity. Thunderstorms occur throughout the area, but are insignificant in terms of affecting the total precipitation quantities. Sometimes they bring local short duration rains or hail accompanied by winds.

SOILS OF THE WHITE CAP STUDY AREA

The major rock types encountered during the soil-hydrological reconnaissance were granite, gneiss, and rhyolite. Soils developed from these rocks will have two features in common--coarse to moderately coarse textures and a low inherent fertility. Associated with the coarser textural classes is a low water-holding capacity. For this reason, many of the land types do exhibit varying degrees of moisture stress on plant growth. Effective moisture, however, is also a function of elevation, aspect, and precipitation.

The land types mapped (see Appendix) in the White Cap study area have been formed by four major processes:

Process	Land Type	Name
Stream action	1	Breaklands
	2	Breaklands
	5	Breaklands
	6	Breaklands
	3	Stream Deposition
Frost Churning	7	Cryoplanation
	9	Cryoplanation
	10	Cryoplanation
	13	Cryoplanation
	14	Cryoplanation
	15	Cryoplanation
Surface runoff	8	Fluvial
Glaciation	11	Valley Trough Wall
	12	Valley Trough Wall
	16	Valley Trough Wall
	19	Valley Trough Wall
	17	Moraine
	18	Glaciated

Major Characteristics of Land Types

Breaklands (Units 1, 2, 5, and 6)

Mapping units on this general landform are shallow (less than 36 inches deep), weak-structured, very rapidly permeable, and have a low water-holding capacity. Soil erosion hazard is "high." Lower elevations and southerly aspects have limited vegetative growth potential due to moisture stress.

Stream Deposition (Unit 3)

Due to the physiographic position occupied by this land type (alluvial valley and stream terraces), considerable variation can and does occur within the land type boundary. Depth, drainage, texture, and stoniness are the main variables. Associated with these variables are important attributes concerning land use and management. The above-mentioned characteristics affect available moisture and consequent species adaptation. Surface stoniness can also vary considerably, from nearly stone-free to very stony. Soil erosion hazard is "low."

Cryoplanated or Frost Churned (Units 7, 9, 10, 13, 14, 15)

These units are most commonly found in the upper mid-elevation to high-elevation zones. The larger portion of these are deep (greater than 36 inches deep), well drained, loam to sandy loam texture, moderate to high overall moisture-supplying capacity, rapid permeability with varying thickness of loess caps up to 8 inches to 10 inches. The erosion hazard on the weak cryoed units is moderately high (Units 7 and 9) while on the remaining cryoed units it is "low." The vegetation potential is "moderate" due to the low temperature regime.

Fluvial (Unit 8--a product of running water and overland flow)

This unit has shallow, loam to sandy loam, single-grain, rapidly permeable soils. It has a low water-holding capacity. Grus is common on this unit. It has a high erosion hazard. Its vegetative potential is "low" due to low available moisture and higher temperatures.

Glacial

Valley Trough Wall (Units 11, 12, 16, 19)--sloped by valley glaciers. For the most part, these are shallow, steep soils.

Moraine (Unit 17)--glacial deposition. --Very deep, loam to sandy loam soils with a high content of coarse fragments ranging from gravel to boulders. In certain areas where the material has been indurated and/or has clay bands, water movement through the soil can be greatly restricted. This excessive moisture can affect land use and management. Most of these soils are quite stable unless deep cuts and fills are made.

Glaciated (Unit 18)--scouring.--Shallow, loam to sandy loam with some loess influence. Very rapidly permeable, moderately low overall moisture-holding capacity. This unit has a low erosion hazard. The vegetative potential is "moderate" due to the low temperature regime.

Summary of Soil Interpretations--White Cap

Very likely, the principal concern will be with the "high-intensity fires."

Physical Characteristics

The soils on most of the study area will not be significantly influenced by fire of either low- or high-intensities due to the dominant soil textures (loamy sand to sandy loam). To some extent, the silts may

be affected. These are the units with loess caps. This possibly will be a deflocculation process with consequent loss of pore space. If and when this happens, a decreased infiltration may occur with a higher runoff and consequently a greater plant moisture stress. This potential occurs only on three mapping units. A possibility exists that on the "silty" surface soils, increased water absorption may occur after a fire. This would be possible on those soils that had an inherent wetting problem associated with the silt-organic matter fractions.

Chemical Characteristics

Large quantities of nutrient ions from the standing vegetation and the litter layer are spread in the ash on the surface of the soil in the form of carbonates, phosphates, and silicates of the cations. Nearly all of the nitrogen is, however, released to the atmosphere as ammonia, gaseous nitrogen, or the oxides of nitrogen and sulphur as sulphur dioxide.

The immediate soil surface is heated and this has some direct effect on the microbiological population, on the physical and chemical properties of the soil colloids, and on the availability of nutrient ions. Usually, this effect will be concerned with the top 1 inch or so of soil. The initial decrease in microbial population is considered temporary and frequently builds up to a wider spectrum and to a greater total population (Nye and Greenland 1960).

The degree of impact of a "high-intensity" fire is probably related to subsurface moisture levels just prior to a burn and the amount and intensity of precipitation before a protective cover can be re-established.

It should be kept in mind that this is a "first approximation" and that observations in the field may serve as a basis to change some of these concepts.

ECOLOGICAL
LAND UNITS

III. ECOLOGICAL LAND UNIT NARRATIVES

Ecological Land Units (ELU's) are the basic compartments for implementing fire management prescriptions. ELU's are recognizable parcels which are ecologically equivalent in terms of their topographic features, vegetation, fuels, and fire potential. (Because they are broadly similar groupings, they also have a great number of other similarities basic to land potential and use.) Any ELU encompasses some variability but within an ELU there are strong and consistent similarities and between ELU's there are significant and consistent differences.

In the course of fieldwork and data analysis in the White Cap study area, six ELU's have been identified and described:

1. Shrubfield
2. Ponderosa pine savanna
3. Ponderosa pine/Douglas-fir south slopes
4. Grand fir/cedar (stream bottoms)
5. North slope communities
6. Subalpine

Unit 4 occurs over a small area so will be considered in the management of adjoining units.

SHRUBFIELD

The shrubfield unit describes areas of seral communities composed predominantly of shrubs with understories of herbaceous species. These communities are the result of multiple, short-interval, high-intensity fires. Conifers are intermingled with the shrub community--sometimes

isolated individuals or groups and sometimes entire stands. Typically, the best representation of the shrub community is on the hot and dry sites. The more moist and shaded sites generally support young stands of conifers.

The shrubfield unit in the White Cap study area is located in the Bad Luck Creek Drainage (it also continues down the Selway River to the west). The type extends from the Selway River (elevation 3,000 feet) to about 6,000-foot elevation and is represented on all aspects. Approximately 13 square miles are included in the shrubfield unit. In terms of landforms, the majority of the unit is composed of breaklands. These are characterized by erosive, weak-structured soils which are rapidly permeable and exhibit low moisture-holding potential. Bad Luck Creek bottom is a stream deposition area with relatively deep, well-drained soils. The drainage also includes a small area of single-grained soils which are also rapidly permeable and have a low moisture-holding capacity. Another small area of the unit has landscapes influenced primarily by frost churning action. These generally have deep, single-grained soils which are rapidly permeable but have good moisture-holding capacity.

There is a rich array of plant species on the unit. The site has been burned repeatedly. Leiberg's (1900) report to the U.S. Geological Society indicated the area had been burned during the period 1859-1898. More modern reports show another extensive fire in 1919 and a smaller one in 1940. Other fire years are discussed later in this section.

Cover types in the unit may be described in three groups for all practical purposes:

1. Bad Luck Creek Riparian Vegetation.--The abundant water and the relatively deep, finer-grained soil adjacent to Bad Luck Creek have a great influence on the streamside vegetation. Beaver activities have altered water levels and created environments suitable for some large willow and alder stands. Redosier dogwood and hawthorn are common adjacent to the stream. Ladyfern is found on some of the more moist sites with heavy soils. A rich flora existing on these sites includes most of the common forest riparian species.

2. The vegetation on the slopes is influenced by aspect through moisture relationships. In the 50+ years since the last general disturbance, coniferous stands have become established in the shrub stands on the north slopes. Trees range from a few years old to stands of 38 to 44 years old. The stands are predominantly lodgepole pine and Douglas-fir, but an occasional ponderosa pine, grand fir, Engelmann spruce, or subalpine fir can be found on these sites. The shrub component of these stands varies from very dense to almost nonexistent, depending on the age of the brush and the coniferous overstory. Common shrubs under these stands are ninebark, serviceberry, thimbleberry, huckleberry, spiraea, ceanothus, mountain maple, rose, and willow. Herbaceous species include strawberry, goldthread, clover, meadow-rue, miterwort, bedstraw, fairy bells, Indian paintbrush, yarrow, arnica, harebell, sandwort, bog orchid, rumex, and many others. Several grasses, mosses, and liverworts are also common on these sites.

3. The south-facing slopes (WSW, S, and SE) in the unit are generally covered with shrub overstories with grass and other herbaceous growth underneath. Coniferous species are sparse, usually Douglas-fir or ponderosa pine occurring individually or in small groups. The old veteran ponderosa pine and Douglas-fir that came through past fires are located on these aspects. Vegetation ranges from good shrub cover to very sparse shrub cover with much bare ground. South slope shrubs include shiny leaf ceanothus, spiraea, rose, serviceberry, mock orange, bitter cherry, chokecherry, oceanspray, ninebark, redstem ceanothus, thimbleberry, and Oregon grape. The herbaceous layer includes grasses, moss, arnica, wild pea, brodiaea, penstemon, Indian paintbrush, arrowleaf balsamroot, phacelia, dogbane, yarrow, sedum, braken fern, clover, cinquefoil, cirsium, buttercup, violet, sego lily, and many others.

No attempt was made to define habitat types on this unit due to the extent and degree of disturbance. After working in the adjacent draws, it would be feasible to extrapolate habitat types. The majority of the area from riverbank to around 6,000 feet is probably Douglas-fir/ninebark with a streamside border of grand fir/pachistima extending a ways out onto east-facing aspects. The bottom may have at least one of the cedar habitats represented in very restrictive creekside bands. At elevations around 6,000 feet, the transition is made out of Douglas-fir into subalpine fir habitat types. Being predominantly south, southeast, and southwesterly aspects, they are most likely subalpine fir/beargrass.

The fuel situation in this unit represents the variability inherent in all units. All fuel components exhibit considerable variability with the exception that aerial fuels are almost absent from the unit.

Fuel appraisal plots indicate relatively light loadings of small diameter branch wood (up to 1.6 cm. diameter) and very heavy loadings of dead brush, both of which contribute to a very fast rate of spread. There is also a moderate loading, although patchy distribution, of large-sized rotten down trees which indicates a potential for fire persistence and for fire to spot ahead into the rotten material.

The effect of the most recent fires is very obvious to the casual observer. Fire scar dates were determined on 16 trees in four small groups of veterans in an area of about 2 square miles. Fire dates identified were 1800, 1818, 1826, 1830, 1844, 1860, 1888, 1890, 1895, 1911, 1934, 1940, and 1951. Three dates occurred on several trees--1890, 1934, and 1940.

As indicated, the Bad Luck Creek area experienced multiple, high-intensity fires that extended over most of the drainage. The fire Leiberg (1900) wrote about in 1900 and the 1919 fire illustrate that in some situations a fire can establish a potential for another fire in a short interval. It is possible that the 1859-1898 fires killed many of the trees on the area and led to shrub establishment and tree regeneration. Several years later when many of the dead trees had dried and/or dried and fallen and the understory was creating some ground fuels, a second fire occurred. This fire, fed by heavy volumes of dead and living shrubs, coniferous regeneration, and other fuels, eliminated heavy fuel quantities, much reproduction, and much of the conifer seed source. Interestingly, the fire seems to have spread across Bad Luck Creek and onto the east-facing slope of adjacent Wapiti Creek and quit. The Bad Luck Creek Drainage has been almost without

fire since 1919. In 1940 a concentration of fuels following the 1919 fire was burned during the fall by a Forest Service employee. Fuels on the Bad Luck Creek area have developed sufficiently to support a spreading fire. Except in very dry conditions, the young Douglas-fir/ lodgepole pine stands on northerly aspects should slow or stop fire spread. It is anticipated that fairly large acreages could burn under natural conditions at this time.

PONDEROSA PINE SAVANNA

The ponderosa pine savanna is typified by a mature ponderosa pine overstory with an open grass/forb and shrub understory. Tree regeneration, when present, is generally ponderosa pine on the dry sites with ponderosa pine and Douglas-fir in the more protected draws and on favorable aspects. The topography is typically very steep and the soils sandy and dry. The growing season is warm and dry. In the White Cap Drainage, the unit is represented on the small face outside the Wilderness boundary between White Cap Creek and Bad Luck Lookout in an area of about 3 square miles. This type is found at other locations within the Selway-Bitterroot Wilderness and is included in this discussion for that reason.

The ponderosa pine savanna occurs on very steep landforms which have been modified predominantly by stream action and water action. There are also some landforms which appear to have been influenced by frost churning. The major types are breaklands and fluvial landforms. The soils on these landforms are generally sandy, loose, coarse-grained soils that are highly permeable to water. They are weak structured and are quite erosive. The sites are classed as lowly productive due to high temperatures and a low soil moisture-holding capacity.

Ponderosa pine is the dominant tree species in this unit. It occurs in a climax dominant, climax codominant, and a seral status in the unit. Ponderosa pine reaches old age and considerable size in this environment. The trees are typically widely spaced and on some sites, crown closure probably never occurs. Ponderosa pine regeneration, where present, is patchy and relatively even-aged. It appears that fire is necessary to reproduction of ponderosa pine on these sites. Douglas-fir grows on most of the sites in this unit. It presently occurs as a codominant in the canopy with ponderosa pine or as reproduction under ponderosa pine/Douglas-fir overstories. Douglas-fir regeneration or young stands are most common along creek bottoms and on east-facing slopes. The contact area with the creek bottom unit allows for some expression of grand fir and cedar. This represents only a very narrow band; a few feet rise in elevation eliminates the grand fir and cedar.

Understories in this unit have a variety of grass species, forbs, and shrubs, depending on the moisture relations of the microsite. The drier site species have more floristic similarities to Palouse grassland vegetation than to any other coniferous forest type (Habeck 1972). Species of grass, like bluebunch wheatgrass, Idaho fescue, and cheatgrass, are common. Forbs and shrubs include arrowleaf balsamroot, wild hyacinth, ninebark, rose, snowberry, spiraea, Oregon grape, clarkia, death camas, dogbane, geranium, sedum, strawberry. Shrubs are sporadically spaced across the slopes, forming continuous shrub understories in draws and on easterly aspects.

This unit includes some of the ponderosa pine habitats. These are found at low elevations on steep slopes with south and southwest exposures on very well drained soils like narrow ridgetops.

The majority of the annual precipitation on these sites occurs during the winter and spring. This factor, plus the physical aspects of the site, results in a long seasonal moisture stress situation. Away from the ridges on more easterly aspects, Douglas-fir habitat types are encountered. This is a reflection of better soil moisture relationships resulting from aspect, topographic position, and land configuration. With this change comes a capability for the land to produce more vegetative matter. The drier of the two Douglas-fir habitat types is Douglas-fir/snowberry. The more moist is Douglas-fir/ninebark.

Loading of fuels in this unit is typically low. Grass cover is a common component throughout the unit. Shrubs are dense only on the more favorable sites and their distribution is quite spotty except in draws. Total fuel loading in a stand on a ponderosa pine/Idaho fescue habitat type sampled represented only 3 tons per acre. This can be contrasted to the next most xeric habitat type sampled (Douglas-fir/snowberry) which averaged 13-1/2 tons per acre.

Under natural conditions fire occurred in the ponderosa pine savanna at short intervals. This represents the most flammable ELU in the study area in terms of fire periodicity. Sites were burned by low-intensity ground fires on an interval of between 10 to 25 years. Fuel provided by annual herbaceous growth and needle cast is capable of supporting a spreading fire during the dry period of every year. Fuels are light

and respond rapidly to changes in relative humidity so the fire season can begin in April and last into October. It is through periodic fire that ponderosa pine is so well expressed on the Douglas-fir habitat types in this unit.

Exclusion of fire for any period of time permits a buildup of pine needles, dead brush, and dead herbaceous material. Because the sites are lowly productive, the rate and extent of the buildup is relatively low. Compositional changes in vegetation also occur. Douglas-fir gains a competitive advantage over the pine on the Douglas-fir habitat types. As tree canopies close and brush species get old, the diversity and cover of brush species decreases.

PONDEROSA PINE/DOUGLAS-FIR SOUTH SLOPE

The ponderosa pine/Douglas-fir unit totals about 10 square miles and is found on south slopes from Wapiti Creek to Paloma Creek and from White Cap Creek to about 6,000 feet. This unit represents the classic ponderosa pine forests of the Rocky Mountains. Large ponderosa pine, often in mixed stands with Douglas-fir and scattered Douglas-fir thickets, typifies the area. The topography is usually steep and the aspect is generally southeast to south to southwest.

In the White Cap Drainage the ponderosa pine/Douglas-fir unit occurs predominantly on breakland and fluvial landforms. The breakland and fluvial landforms have shallow, very permeable, coarse-grained soils on steep (60 to 80 percent) slopes. Moisture stress is a critical factor during the summer. The cryoplanated landform is at the 5,000-foot plus elevation and occupies a very minor portion of the area. Slopes are typically less steep than breaklands (40 to 60 percent).

With the exception of a few other stands in the unit, the cover type is ponderosa pine. Field examination reveals an interesting array of ponderosa pine communities. Stands are dominated by mature ponderosa pine ranging to about 300 years old, but most are 150 to 200 years old. Ponderosa pine regeneration is generally found in areas that have been recently burned. The age distribution appears to be skewed to the older-aged classes. Douglas-fir occurs almost universally through the unit. It is represented as old-aged (100 to 200 years) members of many stands, as well as by younger-aged classes. Douglas-fir reproduction in the 30-year-old range is becoming quite prevalent under the mature overstories. Grand fir is also present in the tree layer of some of these communities, showing its best development in the White Cap Creek bottom and in the bottoms and easterly aspects of side drainages. Grand fir extends out of the bottoms a few feet (vertically) on west- and south-facing aspects. It also extends up the better-formed draws even on south aspects.

Cedar occupies a very narrow band along White Cap Creek and in the moist habitats along the lower reaches of the major side drainages. Cedar is at the southerly extension of its range and is poorly represented in the White Cap Drainage.

Moist cedar/grand fir habitats to dry ponderosa pine/Douglas-fir habitats provide for a diverse array of understory species. In general, the entire unit has a well-developed but open shrub layer with an assortment of grasses and herbaceous plants. Densities of the understory species change in response to effective soil moisture relationships. This seems to be controlled primarily by aspect and position on the

slope relative to ridgetops, draws, and White Cap Creek. Some representative shrub vegetation includes serviceberry, rose, spiraea, snowberry, redstem ceanothus, ninebark, oceanspray, willow, currant, chokecherry, Oregon grape, mock-orange, hawthorn, dogwood, and cascara. The herbaceous species range from dry site indicators like bunchgrass, cheatgrass, arrowleaf balsamroot, yarrow, hawkweed, and penstemons through some more moist site indicators such as goldthread, harebell, lupine, queencup beadlily, meadow-rue, sandwort, fairy bells, twinflower, bedstraw, twisted stalk, feather Solomon's seal, wild pea, goodyear orchid, bunchberry, starry false Solomon's seal, and prince's pine.

Stands which have experienced fires in the last 10 to 20 years have understories that are noticeably lacking tall shrubs and appear to have very adequate grass cover. Within about 10 years, shrubs are evident but are generally short and scattered. By about 30 years, the shrubs are well distributed and well developed. At some time around 50 years, Douglas-fir saplings are well established under ponderosa pine and Douglas-fir.

The ponderosa pine/Douglas-fir unit represents several habitat types. The south slope from the creek terrace to about 6,000 feet is Douglas-fir/ninebark. Within this type there are two significant small inclusions. The smaller of these is a ponderosa pine/Idaho fescue habitat type found at a very low elevation on a southwesterly aspect. The topography is very steep and the soil shallow to bedrock and very coarse-grained. There are also inclusions of the Douglas-fir/snowberry habitat type. These are small areas restricted to dry, rocky ridgetops on

southerly and southwesterly exposures. The grand fir/pachistima habitat type is a significant portion of the unit. It is restricted to the narrow band between the White Cap Creek and where the slope steepens; and is also found along deeper draws on south slopes. Grand fir extends into side drainages going upslope on easterly aspects to about midslope and upslope on west slopes within a few feet of vertical distance. There is a small representation of cedar habitat types (mostly cedar/pachistima, with one small area of cedar/ladyfern) on the edge of White Cap Creek and extending up the creek bottoms of major side drainages.

The fuel situations on this south slope unit presents the greatest challenge for fire management in the White Cap Drainage. This unit is relatively productive in terms of biomass production and has evolved with frequent low- to moderate-intensity fires. Fuel accumulation effects from past fire suppression are significant in the ponderosa pine/Douglas-fir unit. Fuel has accumulated quite uniformly over virtually the entire area, providing a continuity that probably did not exist as extensively under natural conditions. Indicated rates of fire spread for the south slope unit are relatively high. This is due to heavy quantities of small fuels (branchwood, dead forbs, and litter) which accumulate under stands over time. Decadent shrubs and dense patches of coniferous reproduction provide an additional fuel load. The short distance from the ground fuels to the crowns of Douglas-fir regeneration presents a crown fire potential. The fire spread model (Rothermel 1972) indicates the highest potential for fire intensity in the south slope unit. The first objective in fire management on these sites should be to reduce fuel quantities on portions of the area to break up the fuel continuity.

The ponderosa pine/Douglas-fir unit has experienced frequent short-interval fires that were of a low to moderate intensity. The typical fire burned on the ground and reduced ground fuels and eliminated much of the small-sized reproduction. Annual fuel accumulations were probably sufficient to support spreading fires annually. A fire cycle of 5 to 50 years is indicated by field examination and literature review. This is not to say stands did not get older than 50 years or that fires were always ground fires. Some stands undoubtedly became much older and in the course of development accumulated fuels to support a high-intensity fire that resulted in total stand replacement.

NORTH SLOPE COMMUNITIES UNIT

This unit is comprised of productive forest communities which are represented by continuous tree cover, all-age classes, and a well-developed shrub layer. In the White Cap Drainage this unit extends from creek bottom to ridgetop and from the Wilderness boundary to the Peach Creek boundary of the study area. Another portion of the unit extends from Cooper's Flat to the Granite/Falls Creek Divide on the north slope and from White Cap Creek to about 7,000-foot elevation. The two areas total about 20 square miles. Topographic features are very important in delineating this unit from the subalpine fir unit.

The landforms associated with this unit are predominantly influenced by cryoplanation and glaciation. Soils are generally deep, coarse-textured, and well drained. Some of the soils have a thin loess cap.

Moisture relationships remain favorable for plant growth all summer. The most productive sites in the area are found on these soils. The topography is steep, ranging from 20 to 100 percent. There are some rock outcroppings, but generally the soil development permits continuous forest cover.

This unit possesses the greatest floristic diversity. Starting along the stream bottom the following tree species may be encountered in various successional stages: cedar, cottonwood, western yew, grand fir, ponderosa pine, Douglas-fir, lodgepole pine, Engelmann spruce, quaking aspen, subalpine fir, and whitebark pine. It was on this unit that the only western larch known to be in the White Cap Drainage was found. A great variety of understory species can be found too: prince's pine, twinflower, pyrolas, wake-robin, fairy bells, goodyear orchid, anemone, huckleberry, foam flower, bunchberry, trail plant, wild ginger, cascara, starry false Solomon's seal, queencup beadlily, goldthread, menziesia, currant, oceanspray, honeysuckle, ninebark, mountain maple, willow, mountain ash, meadow-rue, thimbleberry, serviceberry, alder, and beargrass.

North slope stands generally develop over a much longer period than the stands on south slopes, because of longer fire cycles. Homogeneous stands are easier to identify on the ground and seem to be larger in size than on south slopes. Fires usually burn at highest intensities on north slopes, contributing to stand replacement.

A rich array of habitat types is expressed in the North Slope Unit. The types described by Pfister, et al. (1972) best accounts for the gradation of environment in the unit. There are some limited areas of cedar habitat types adjacent to White Cap Creek. They grade immediately into the grand fir/clintonia habitat type, clintonia phase. The grand fir/clintonia habitat type, beargrass phase, at midslope (4,500 to 5,000 feet) reflects drier conditions. Still higher the grand fir/beargrass habitat type is found. At about 5,500 to 6,000 feet the subalpine fir habitat type series is fast encountered. Three phases of the subalpine fir/clintonia habitat type occur on the more moist sites: clintonia phase in deeper draws and on moist flats; menziesia phase on cool north and east slopes; and the beargrass phase on drier south and west slopes and ridgetops. The subalpine fir/menziesia habitat type occurs extensively on the open upper slopes of the unit. The subalpine fir/luzula habitat types occur from about 6,700 to 7,000 feet with the beargrass phase on the drier sites and the menziesia phase on the more moist sites.

Fuels on the north slope unit represent the heaviest loadings. This can be explained in terms of the very high site productivity and the long fire cycle. The fuels on specific sites can vary greatly due to the infinite number of possible combinations of species, ages, conditions, stand histories, etc. Generally speaking, the stands in the White Cap are relatively young (average 100 to 150 years old), so "jackpot" fuel situations are scarce. There are some small areas where lodgepole pine stands have deteriorated due to age and biological agents, and the

more tolerant subalpine fir is coming up through the down trees. The spruce budworm has defoliated some of the Douglas-fir and subalpine fir stands for the past several years. Needle cast, dead needles on trees, and possible mortality will alter fuel situations over time.

Fire has played a very significant role in north slope communities. Fire cycles in north slope communities are long-interval--probably 150 to 200 years. This means that the fires are often high-intensity fires that bring complete stand replacement. Fires do occur under conditions in which low-intensity ground fires burn small acreages and kill only a few trees, but the high-intensity, stand-replacing fire is part of the ecology of north slope communities.

SUBALPINE UNIT

The subalpine unit is composed of high elevation areas where plant growth is affected by the cool, relatively dry climate and short growing season. The forests are often discontinuous due to interruptions of topography from rock, rockslides, snowslides, cliffs, etc. On the higher portions of the unit, soils are poorly developed. At the extreme elevations, the unit extends above the timberline.

In the White Cap Drainage this unit is located at elevations above the south slope ponderosa pine/Douglas-fir unit and in the upper White Cap Creek above the north slope community unit. There are some minor inclusions of the cedar/grand fir bottom type and north slope community on the north-facing slope of the South Fork of Lookout Creek. The subalpine unit includes about 54 square miles in the study area.

There is a variety of tree species represented in the unit. The most common is lodgepole pine which grows on all aspects to around 7,000 feet. Subalpine fir also grows on all aspects up to timberline. Whitebark pine is another very common species. Engelmann spruce grows on the cooler, more moist sites in the unit. Douglas-fir is a common seral species to at least 7,000 feet on southerly aspects. Alpine larch thrives at the 7,500+ elevations along the rugged ridges of the Bitterroot Crest. Understory vegetation can be discussed in terms of the dry sites (southeast to westerly slopes) and wet sites (north slopes, cirque basins, and bogs). The understory on dry sites is dominated by huckleberry, beargrass, and grouse whortleberry. There are some alpine grasses and several sedges on these sites, as well as several other forb species. The wet sites have dense understories of menziesia, with beargrass, huckleberry, Labrador tea, mountain heather, and several species of sedges.

Several habitat types can be encountered although three are most common. Subalpine fir/whitebark pine occurs at the high elevations where the environment is so restrictive that the crown closure cannot occur. Below subalpine fir/whitebark pine, and on the drier slopes, subalpine fir/beargrass is found down to elevations between 5,500 and 6,000 feet. Subalpine fir/grouse whortleberry is found occasionally on microsites that are a little more moist. Below the subalpinefir/beargrass, the Douglas-fir/beargrass and grand fir/beargrass habitat types can be found on sites a little warmer and more moist. The other common habitat type,

subalpine fir/menziesia, is restricted to north slopes, bogs, cirque basins, and other sheltered wet sites. There are some subalpine fir/pachistima habitat types found along creek bottoms and on the moist sites with good soil development.

Fuels on this unit vary considerably from north to south slope. Generally speaking, the south slopes have lighter accumulations of all fuel components than the more productive north slopes. Rates of spread in the subalpine unit are low on the average. Greater fuel accumulations occur on some sites where biological agents contribute to the breakdown of lodgepole stands and subalpine fir (or subalpine fir/Engelmann spruce) stands come up from below. The fuel situation thus created is familiar and may be characterized by the Sleeping Child Drainage prior to 1961. The fire season at subalpine elevations is generally a short one. The discontinuities in fuels in this unit have been effective barriers to fire spread in the past. Bill Holman, District Ranger at Moose Creek, noted that most large fires in the past on the Moose Creek District stopped in this zone within about 10 miles of the Bitterroot Divide and that all fires had run their course by the time they were within about 5 miles of that Divide. The discontinuities are not only topographic, but also include vegetative breaks.

Fire cycles in the subalpine unit are moderatley long, averaging from 100 to 250 years. This, coupled with the low productivity of the sites, reduces the significance of past fire suppression on fuel accumulations. Quite probably our past fire control efforts have had a minimal effect on the natural role of fire in this unit.

CEDAR/GRAND FIR STREAM BOTTOMS

The cedar/grand fir stream bottom unit in the White Cap Drainage is restricted to a very narrow band adjacent to the major streams. The vegetation is significantly unique and is, therefore, described; but the unit is too narrow for use as a fire management prescription unit. The stream bottoms are made a part of the other adjacent units for fire management.

The dominant landform in the stream bottom unit is the result of glacial deposition (moraine). The soils are characteristically very deep and finer textured than the rest of the White Cap Drainage. Bands of clay and other relatively impervious layers in some areas greatly affect the soil moisture relationships. These sites are generally on very gentle slopes and do not range very many feet above the water table.

Habitat types indicative of the best moisture relationships are found in the stream bottoms. The high elevation components are subalpine fir/menziesia at the upper elevations and subalpine fir/pachistima on the more moist and slightly warmer sites. Grand fir/pachistima, cedar/pachistima, and cedar/ladyfern occupy the warmer sites in order of increasing moisture regimes. These habitat types are the most productive habitat types in the White Cap Drainage.

The stream bottom forest communities have a great number of species both in overstory and understory. Cedar, grand fir, Engelmann spruce, and subalpine fir are the major late successional and climax tree species. Douglas-fir, ponderosa pine, lodgepole pine, and cottonwood occur as seral species in the unit. The common understory species are western yew,

prince's pine, twinflower, pyrolas, fairy slipper, wake-robin, fairybells, goodyear orchid, anemone, huckleberry, trail plant, wild ginger, cascara, ladyfern, starry false Solomon's seal, queencup beadlily, goldthread, beach fern, menziesia, currant, oceanspray, virgin's bower, orange trumpet flower, ninebark, maple, miterwort, mountain alder, redosier dogwood, thimbleberry, serviceberry, Labrador tea, beargrass, and bedstraw.

Fuels in the streamside unit are generally quite heavy. The sites are highly productive and fire is not a frequent event in the unit. The fire frequency on these sites probably approaches the 450- to 500-year interval suggested by Daubenmire (1968) which allows for long periods of community development and fuel accumulation. The typical fire in these communities is a high intensity one which sets the stage for a new forest community. The stream bottom communities usually burn in conjunction with adjacent sidehills in larger fires. Past suppression activities have probably had little effect on fire's role in stream bottom units.

SUMMARY OF THE ROLES OF FUEL AND FIRE IN ECOLOGICAL LAND UNITS

Flammability can be approached as an interaction between plant communities and environment over time. If time has been long enough that communities are well established, then practically every year during the dry season a significant fire is possible in such communities as grasslands, ponderosa pine savanna woodlands. This occurs because these communities bring certain properties to the ecosystem that enhance flammability. Under pristine conditions, these communities would generally

experience lower-intensity fires than those in other communities. In other words, these associations of plants can maintain their composition and structure through periodic burning because inherent plant characteristics enhance fire propagation. This explanation implies that plants which have survived fires for thousands of years may not only have selected survival mechanisms but also inherent flammable properties that contribute to the perpetuation of fire-dependent plant communities (Mutch 1970). But a fire propagation energy source is not always readily available in all plant communities. In lodgepole pine, Engelmann spruce, and north slope communities, a physical deterioration over time is probably the factor which finally induces high flammability (thus earlier stages in stand development may be lowly flammable; e.g., the term asbestos forests for young-age classes of lodgepole pine). Bloomberg (1950) described the development of high fire hazard in a spruce-fir forest in Canada caused by the accumulation of windfall and other organic matter over long periods of time. Lightning strikes no longer caused spot burns, but resulted in major conflagrations in exceptionally dry seasons. In this instance, high flammability was finally predisposed by the physical accumulation of large amounts of dead organic matter. Wellner's (1970) comments should be considered in the light of these observations by Bloomberg. Bloomberg accounted for a spectrum of fire intensities from the spot fire in spruce-fir to the conflagration. The evaluations of fire potential in Rocky Mountain forests must account for variations in plant succession and fuel succession in time and space. The spectacular fires are readily remembered, but it is necessary to understand and consider the contribution

of smaller-sized and low-intensity fires to ecosystem functioning and vegetation mosaics. So there is not one kind of fire in the northern Rocky Mountains but many kinds; and the continuum of fire treatments on these landscapes is closely integrated with the variability of vegetation and fuels in time and space.

In the White Cap, fire histories have been determined by evaluating wedges taken from fire-scarred trees in ponderosa pine savanna and the ponderosa pine/Douglas-fir zone. Fires in the pine savanna could generally be characterized as low-intensity surface fires. Data collected indicate that the average savanna fire cycle averages 20 years, with a range from 1 year to 73 years (Table 2). These are results from dating fires from fire scars, and it must be remembered that this technique is a conservative estimate of fire periodicity. The fire must be of sufficient intensity to scar the tree in order to read fire history from annual rings. For example, there was a fire in this open pine stand in 1961 that does not show as a fire scar.

Under pristine conditions, fire cycles in the ponderosa pine/Douglas-fir zone averaged about 9 years with a range from 1 year to 28 years (Table 3). With these kinds of cycles, fires in this zone at one time were probably often characteristically low-intensity surface fires. Today the potential in this zone is for higher-intensity fires over larger areas than may have occurred naturally. Fire has been much less of a factor in these stands in recent years and there is a compositional shift from ponderosa pine to Douglas-fir.

In the north slope communities we see a patchwork of small mosaics and the green carpet effect of extensive uniform stands that most likely resulted from the conflagration type of fire. These different kinds of stands on north slopes from small mosaics to widespread even-aged stands probably reflect the observation of Bloomberg that was cited earlier. Although at earlier stages of stand development fires may reach natural limitations at small sizes, these north slope stands will also reach a conflagration cycle on an average of 150 to 200 years.

Fires in the subalpine zone will often be characterized by small, spotty, ragged burning conditions in the subalpine fir habitat types. There will also be more extensive, higher-intensity fires in this zone when conditions of heavy downfall exist (e.g., crown fires in decadent lodgepole). However, in the White Cap this zone is typically comprised of significant fuel discontinuities due to the preponderance of rock outcrops and scouring effects of glaciation.

Table 1 indicates the fire periodicity determined by examination of fire scars on 18 trees (15 mature ponderosa pine and three 50-year-old Douglas-fir) that survived the multiple burns in Bad Luck Creek. For the period of 170 years, there were 13 fire years--a fire on the average of every 13 years. The shrubfield must have supported timber over a grass/shrub understory similar to the ponderosa pine/Douglas-fir south slopes or the ponderosa pine savanna prior to the type conversion following the 1919 fire.

The longest fire cycles in the White Cap occur in the moist ravine and stream bottom cedar and grand fir habitats. On these sites, fire cycles approach Daubenmire's upper estimate of 450 to 500 years.

The analysis of fuels in the White Cap Drainage indicates some interesting relationships regarding fire potential (Tables 4 and 5). Highest spread rates are indicated for the shrubfields in Bad Luck Creek. An intermediate spread group is comprised of cedar/ladyfern and grand fir/pachistima habitat types. The lowest spread rates were for subalpine fir, Douglas-fir, cedar/pachistima, and ponderosa pine/Idaho fescue habitat types. All of the results in tables 4 and 5 are for zero percent slopes. When existing stand slopes are utilized in the fire spread model (Table 6), then ponderosa pine/Idaho fescue, grand fir/pachistima, cedar/ladyfern, and Douglas-fir/ninebark fall in an intermediate spread class for the White Cap study area.

Fire intensity potential, however, is greatest in the Douglas-fir/ninebark type and least in the shrub type. Cedar, ponderosa pine, and two of the subalpine fir habitat types are intermediate in intensity.

The greatest amounts of large fuel components (over 4 inches in diameter) are found in the Bad Luck shrubfields, subalpine fir/menziesia, subalpine fir/pachistima, and cedar/ladyfern (Table 4). The high percentage of rotten large fuels in Bad Luck shrubfields is attributed to a carryover of down trees following multiple burns. Intermediate fuel loadings of this size class were measured in the cedar/ladyfern habitat type. Lower amounts of 4-inch-diameter material are characteristic of the subalpine fir/beargrass and Douglas-fir/ninebark habitat types. This large dead fuel was not found in the Douglas-fir/snowberry and ponderosa pine/Idaho fescue habitat types.

Table 1.--Shrubfield fire history determined from ponderosa pine and Douglas-fir[1/]

Fire year	Yearly interval	No. trees with fire scar[2/]
1955		1
	4	
1951		1
	11	
1940		10
	6	
1934		6
	23	
1911		1
	16	
1895		1
	5	
1890		6
	2	
1888		1
	28	
1860		1
	16	
1844		1
	14	
1830		1
	12	
1818		1
	18	
1800		1

Fire scar stand cycle averages 13 years.

[1/] Three Douglas-fir were checked.

[2/] Eighteen trees were sampled using an increment borer which, at best, provides a conservative record.

Table 2.--Ponderosa pine savanna fire history determined from ponderosa pine wedges

Fire year	Yearly interval	No. trees with fire scar 1/
1969		2
	42	
1927		3
	7	
1920		1
	2	
1918		1
	41	
1877		1
	8	
1869		1
	1	
1868		1
	9	
1859		1
	11	
1848		1
	9	
1839		1
	20	
1819		1
	73	
1746		1

Fire scar stand fire cycle averages 20 years.

1/ Five trees sampled in this stand and each tree had multiple fire scars.

Table 3.--Ponderosa pine/Douglas-fir zone fire history determined from fire-scarred ponderosa pine wedges

Fire year	Yearly interval	No. trees with fire scar[1/]
1938		1
	15	
1923		1
	3	
1920		1
	[2/]1	
1919		1
	1	
1918		1
	1	
1917		1
	7	
1910		2
	2	
1908		1
	2	
1906		1
	2	
1904		1
	28	
1876		1
	7	
1869		1
	17	
1852		1
	5	
1847		1
	24	
1823		1
	18	
1805		1

Fire scar stand fire cycle averages 9 years.

[1/] Ten trees sampled along 2-mile transect at 3,800 feet in this zone between Fritz Creek and Wapiti Creek.

[2/] Because of counting errors in dating fire scars, these 1-year intervals might be combined.

Table 4.--White Cap fuel and fire potential by habitat type. Slope standardized at 0 percent, fuel moisture of 5 percent

Habitat types	Spread rate (m.p.h.)		Intensity	Large fuel	Rotten	Duff	Brush	Average slope	Aspect	No. plots
	4	20								
	Ft./min.		B.t.u./ ft.^{2}/min.	Lb./ac.	Percent	Lb./ac.	Lb./ acre	Percent	Degree	
Shrubfield	17	83	780	76,100	92	62,000	4,959	49	19± 12	33
AF/Beargrass	3	19	1,130	27,600	77	21,800	365	42	19± 19	53
AF/Menziesia	3	24	1,810	86,500	48	21,500	2,319	28	23± 37	35
AF/Pachistima	6	30	2,290	109,400	42	56,100	504	13	13± 81	11
WC/Pachistima	5	32	1,720	55,300	62	59,100	106	6	17± 99	8
PP/Idaho fescue	6	45	1,610	0	0	2,600	1,250	70	18±133	5
DF/Snowberry	4	23	2,070	0	0	18,500	369	40	18±134	5
WC/Ladyfern	12	72	1,270	80,500	100	529,600	23	5	16±135	5
DF/Ninebark	5	30	2,921	20,200	93	26,500	861	62	20± 37	59
GF/Pachistima	10	56	2,560	38,400	72	57,700	426	42	20± 34	97

Table 5.--White Cap fuel and fire potential by timber type; 0 percent slope, dead fuels (3 branchwood size classes, dead grass and forbs, litter), 5 percent moisture content, and effective wind in canopy is 2 m.p.h. and 10 m.p.h.

Species	Spread rate (m.p.h.)		Intensity	Large fuel	Rotten	Duff	Brush	Average slope	Aspect	No. plots
	4	20								
	Ft./min.		B.t.u./ ft.^{2}/min.	Lb./ac.	Percent	Lb./ac.	Lb./ acre	Percent	Degree	
PP	9	57	2,810	34,500	78	26,500	742	52	19± 7	103
LP	2	13	1,770	63,000	58	10,200	2,404	25	24± 33	41
DF	9	72	1,700	47,900	92	66,200	1,433	50	23± 31	80
S	6	31	2,840	89,900	35	75,000	657	28	17± 65	30
AF	3	20	1,300	15,100	67	25,100	1,124	50	14± 75	25
GF	2	6	2,290	5,900	0	56,400	14	9	14±186	5
C	7	40	1,490	60,200	100	289,900	96	5	19±125	10
Shrub	12	38	540	19,000	69	25,800	5,108	45	17± 95	17

Table 6.--White Cap fire potential in dead fuels.

Existing slopes used in calculations

Habitat type	Rate of spread Wind (m.p.h.) 4	20	Intensity
	Ft./min.		B.t.u./ft.^{2}/min.
Shrub	26	93	781
AF/Beargrass	4	20	1,128
AF/Menziesia	4	25	1,813
AF/Pachistima	6	31	2,286
WC/Pachistima	5	32	1,725
PP/Idaho fescue	17	60	1,605
DF/Snowberry	5	24	2,066
WC/Ladyfern	12	72	1,266
DF/Ninebark	10	35	2,922
GF/Pachistima	14	60	2,560

IV. VALUES TRANSCENDING WILDERNESS BOUNDARIES

In the process of managing wildernesses, we must consider that programs within the boundaries have ramifications that transcend those boundaries. We cannot manage any parcel of land in a vacuum--management actions will necessarily affect adjacent and remote areas to some degree. Off-site evaluations must be approached objectively, looking at all options in terms of the short and the long run.

Fire management planning in the White Cap area must consider at least the following off-site concerns:

1. The anadromous fishery of the Upper Selway River
2. Air Quality
3. Adjacent nonwilderness management units

SELWAY ANADROMOUS FISHERY

The Selway River provides part of the natural habitat for two anadromous fish species--the chinook salmon and the steelhead. These species find suitable spawning and rearing habitat in the rocky stream bottoms and the high-quality water of the Upper Selway River Drainage. Man's activities downstream on the Clearwater, Snake, and Columbia Rivers have created serious impediments to the anadromous fishery. Dams alter river flow, provide effective barriers to fish passage, warm the water, and cause nitrogen enrichment, all of which annually kill portions of the fish crop. Generator turbines in dams also account for many seabound individuals. Addition of pollutants to waterways has affected the chemistry and physical characteristics of the water; and, therefore, the biotic component. The alteration of natural streambeds as a result of on- and off-site activities has reduced fish habitat.

Under natural conditions, the Selway River and its tributaries provide a marginal anadromous spawning habitat. The fine material contributed through natural geologic erosion maintains a relatively high fines content in the spawning gravel. The fines content of spawning gravel is currently being monitored in the Selway River, but no field studies are being conducted to relate activities and events on the landscape to spawning bed composition dynamics. Certainly, in the past, fires, floods, landslides, snowslides, logjams, icejams, etc. have occurred, influencing the evolvement of the aquatic components of the system. Our land management activities should then logically be directed as closely as possible to allowing such natural perturbations to occur with natural frequencies to perpetuate the long-range viability of the anadromous fishery resource. This course will produce a cyclic fish population. Natural disturbances affect all other populations and aspects of the environment in the same way to perpetuate the diversity so necessary to stability of systems through time.

Regional Office fisheries biologist, Don Duff, reviewed the literature and took a fishery inventory, and his observations made on a field trip during May 1972 follow:

> In July 1970, Region 1 of the Forest Service initiated a fire study in the Whitecap Creek drainage of the Selway-Bitterroot Wilderness. The objectives of this study will be to interpret fire's contribution to ecology of this natural area in order to arrive at a sound fire management policy for letting fire assume more of a natural role in wilderness areas.
>
> As an aid to the wilderness fire study team, the following fisheries inventory data have been collected from a partial review of literature until field surveys can be completed in 1972.

Stream Resources (Murphy and Metsker 1962)

A. Whitecap Creek

1. Mouth enters at river mile 70 of Selway River.
2. Mainstem 22 miles in length.
3. Mouth to first (15-foot fish barrier) falls is 13.2 miles.
   a. Falls is total block to upstream fish movement.
   b. Fifty-five percent riffle from mouth to falls.
      (1) 27,193 square yards Chinook gravels.
      (2) 30,490 square yards steelhead gravels.
4. Mouth to second (20-foot fish barrier) falls is 15.8 miles.
   a. Falls is total block to upstream fish movement.
   b. Stream section between these two falls contains:
      (1) 20,524 square yards Chinook gravel.
      (2) 21,706 square yards steelhead gravel
5. Flow estimate 64 c.f.s., water temperature 57°F. at 0800 8/26/58.

B. Canyon Creek - Tributary to Whitecap Creek

1. Mouth enters Whitecap Creek at stream mile 9.
2. Mainstem is 10 miles in length but only 8.5 miles surveyed due to excessive gradient at headwaters section.
3. Surveyed within the 8.5 miles stream reach were:
   a. 3,235 square yards steelhead gravel.
   b. No suitable Chinook gravels found.
4. Flow estimate 25 c.f.s.; water temperature 58°F. mouth, 51°F. head on 8-27-58.

C. Cooper Creek - Tributary to Canyon Creek

1. Mouth enters Canyon Creek at stream mile 1.5.
2. Mainstem is 5 miles in length, but only 1.3 miles surveyed due to steep gradient and large rubble at that point.
3. Within the 1.3 mile-surveyed section were:
   a. 124 square yards steelhead gravel.
   b. No suitable Chinook gravels found.
4. Flow estimate 9 c.f.s., water temperature 54°F. at 0935, 8-27-58.

D. Paloma Creek - Tributary to Whitecap Creek

1. Mouth enters Whitecap Creek at stream mile 10.
2. Mainstem is 4 miles in length of which only 1 mile was surveyed due to steep gradient encountered.
3. The 1-mile survey section contained:
   a. 637 square yards steelhead gravel.
   b. No suitable Chinook gravel found.
4. Flow estimate 5 c.f.s., on 8-26-58.

The following table summarizes available data on the Chinook salmon fry within the drainage.

Table 1. Indian Creek Hatching Channel Spring Chinook Fry Distribution in Whitecap Creek Drainage

Year	Release Site	No. of Fry
1968	Paradise G.S.	22,500
	Cooper Flat	65,000
	15 miles above mouth	150,000
1969	Paradise G.S.	15,300
	5 miles above mouth	109,000
	10 miles above mouth	126,000
	15 miles above mouth	90,000
1970	Paradise G.S.	15,300
	Cooper Flat	76,160
1971	Paradise G.S.	216,492

Chinook salmon redd counts conducted annually by Idaho Fish and Game Department noted 4 redds in Whitecap Creek for the first time in 1970 since the fry transplants. No redds were observed during the 1971 count; however, Magruder District personnel observed 2 salmon at Cooper's Flat in mid-September.

Lake Resources

The Whitecap Creek drainage contains numerous lakes most of which have not been surveyed. Several of the larger more important lakes in the drainage which have a fishery and are stocked frequently by the Idaho Fish and Game Department are:

1. Triple Lakes (3)
2. White Cap Lakes (3)
3. Canyon Lake

Approximately sixty additional lakes are present within the drainage which may or may not have fisheries potential but are unsurveyed at present.

Water Quality

Present water quality within the drainage is considered excellent. The Magruder District has established a water sampling station on Whitecap Creek above the mouth to monitor conditions on a regular basis.

Results of one water sample chemical analysis taken November 8, 1971, above the mouth, were as follow:

Air temperature	29°F.	
Water temperature	32°F.	
Time	0950	
pH	7.7	
CO_2	>5 p.p.m.	
DO	11 p.p.m.	
Alkalinity (phth)	0 p.p.m.	(est. % of OH CO_3HCO_3)
(M.O.)	59.8 p.p.m.	(Methyl orange test-total alkalinity)
Hardness (total	17.1 p.p.m.	
Turbidity	0.25 JTU	
Free Acidity	0 p.p.m.	
Flow (estimated)	40 c.f.s.	

While fire may have some temporary effects on mountain stream-flow regimes, no long lasting effects can be expected. Recovery rate of riparian vegetation, streamflows, and temperatures can be expected to occur relatively soon after fire occurrence.

Berndt (1971) found that after a fire on several mountain streams in north-central Washington stream temperatures fluctuated very little for the volume of flow present in the channel.

Johnson and Needham (1966) found no significant increase in ionic composition of streamwater following a large fire in the Sierra Nevada Mountains of California at an elevation of 7,000 feet above sea level.

Biswell and Schultz (1957), in a study of prescribed burning, found no indication of surface runoff and erosion that could be related to the burning itself.

Friedrich (1955) states that damages caused by fire depend not so much on whether the fire is wild or planned but on soil, vegetative, and stream characteristics of the watershed before and after the fire.

AIR QUALITY

Air is a resource shared by everyone. Circulation in our atmosphere makes it possible for smoke to be considered a nuisance downwind from its origin. The magnitude of the impact depends on many things, including a person's attitudes toward wood smoke smell and a smoky sky. Fire management in wildernesses must consider the possible downstream effects of smoke originating from wilderness fires. Again, it is essential to consider the entire situation over the long run.

Research indicates that the most significant off-site effects of smoke are those concerned with particulate material. The chemical constituents of smoke are innocuous within a few hundred feet of high-intensity fires. By the time smoke arrives over population centers, it cannot be equated with automobile exhaust and industrial smoke--in fact, its importance is almost entirely limited to its impact on visibility (Hall 1972).

That total fire exclusion cannot be accomplished is becoming a recognized reality from a practical standpoint. Fire has accomplished the link between the organic and elemental world and has been the major cycling agent for nutrients in the biological systems of the Rocky Mountains. We must recognize fires at some point in time in all of our wildland systems unless this cycling can be accomplished by other agents. Delaying the natural frequency of fire for a significant period of time will generally result in a potential for a very high-intensity, large fire. If fire is inevitable--then so is smoke. Can we trade smoke from today's fires for a holocaust and its smoke tomorrow?

Diversity of opinion is great even among the air pollution control officers. One said, "addition of any smoke to an already overburdened airshed is undesirable," and in contrast another said, "what may cause air pollution in the short run may be good ecology in the long run."

ADJACENT NONWILDERNESS LANDS

There is a concern that fire management other than strict suppression represents a hazard to adjacent nonwilderness lands. No meaningful blanket statement of the situation or management direction is possible. Ultimately, fire's ecological role will be taken into account in the management of all wildlands. At that time, the ecology of specific parcels of the land will be integrated as a part of the potential of the land to meet the needs and desires of society. Fire planning in many cases may be complementary across a wilderness boundary. In other cases, the line may represent a hard and fast boundary between two very different kinds of fire management. In any case, the planning process must include recognition of all factors concerning fire's role and potential on specific sites.

In considering fire management in wilderness we must consider:

1. What are the impacts of allowing fire to play a more nearly natural role?

2. What are the impacts of all other alternatives?

A valid assessment must be based on impacts over the short and long run.

V. FIRE MANAGEMENT PLAN FOR THE WHITE CAP DRAINAGE

A. INTRODUCTION

Interpretations previously presented of the vegetation, landforms, fuels, and fire potential for the ecological land units provide the necessary information to develop the fire management plan for the 100-square-mile White Cap Drainage. The fire management plan consists of three parts:

1. Basic assumptions, or universal planning criteria, for the drainage as a whole.
2. Prescriptions, or specific operational plans, on a zone-by-zone basis (observation, initial attack, or observation plus attack); what will be done and when.
3. Pre-attack planning (see map in Appendix); or how fires will be managed once they occur and where management actions will be taken.

B. BASIC ASSUMPTIONS

This section establishes certain drainage-wide principles that serve as frames of reference for the preparation of prescriptions and pre-attack plans:

1. Fire management plans in wilderness will be compatible with the goal of perpetuating natural and unmodified ecosystems in wilderness and with management goals outside wilderness.
2. Since lightning causes 98 percent of the fires in the study area, man-caused and lightning fires will be treated in the same manner.
3. Fires will be contained within the study area.

4. Line officer monitoring of all fires within the White Cap Drainage will be required.
5. Surveillance of going fires will be provided by ground crews, visual air patrols, infrared patrols, and/or lookouts.
6. Fires will be suppressed to protect human life and property.
7. Cutoff dates for initial attack or observation will be related to burning conditions rather than arbitrary dates.
8. Prescriptions and preattack plans will be specifically tailored to the five major ecological land units identified in the White Cap Drainage (shrubfield, ponderosa pine savanna, ponderosa pine/Douglas-fir, north slope communities, and subalpine).
9. An aggressive man-caused fire prevention program will be followed.
10. An inform and involve plan will be activated to interpret fire management activities.

C. FIRE MANAGEMENT PRESCRIPTIONS FOR ECOLOGICAL LAND UNITS (FIRE MANAGEMENT ZONES)

The fire management prescriptions are intended to provide the line officers and forest dispatchers with guidelines that state what will be done with fires and when different actions will be taken. The three courses of action are suppression, observation, and observation and suppression. The following prescriptions are specific to individual fire management zones and take into account such things as fuels, fire potential, and natural barriers to fire spread:

Shrubfield Zone

1. Observation of fires with line officer monitoring.
2. Contain fire within study area.
3. During hunting season (a) buildup index less than 170, fire observation and line officer monitoring, (b) buildup index over 170, initial attack and fire suppression.

Ponderosa Pine Savanna Zone

1. Buildup index less than 170 and increasing: observation and monitoring of going fires.
2. Buildup index of 170 or more and increasing: man going fires to contain them within the unit by indirect attack methods.
3. Buildup index less than 170 and declining: observation and monitoring of going fires.

Ponderosa Pine/Douglas-fir Zone

1. Fire below 4,500 feet elevation: initial attack and fire suppression.
2. Fire above 4,500 feet elevation:
   a. Buildup index less than 170 and increasing: observe and monitor fires; suppress going fires when buildup index exceeds 170 by direct attack, or along predetermined control lines.
   b. Buildup index greater than 170; man to limit fire growth to predetermined control lines through direct and indirect methods.
   c. Buildup index less than 170 and declining: observe and monitor going fires.

North Slope Communities Zone

1. Observe and monitor going fires on a season-long basis.
2. Contain fires in this zone within the study area.
3. Buildup index 170 or above: suppress perimeters of going fires which are in proximity to the west or east ridges of Peach Creek.

Subalpine Zone

1. Observe and monitor going fires on a season-long basis.
2. Contain fires in this zone within the study area.
3. Buildup index above 170 (as measured at Hell's Half-Acre Lookout): suppress fires where fuels are continuous across the Bitterroot Crest.

D. PREATTACK PLAN

The preattack plan states how fires will be managed and where management actions will be taken. In operation of the White Cap Fire Management Plan, new fires would routinely be reported to the Magruder District for appropriate management action and to the forest dispatcher. If the fire is within a fire management zone where observation and monitoring are called for, no suppression action is taken. When a new fire is located in the study area, an aerial observer will report the fire to the district and file a Wilderness Fire Management Report with the Supervisor's Office and the Ranger District. This report will contain the following information:

1. Date
2. Fire location
3. Estimated fire size
4. Elevation
5. Aspect
6. Slope
7. Fuels
8. Fire behavior
9. Potential problems

The report should be updated daily on going fires. This information is made available to the Bitterroot Forest's Fire Management Committee (comprised of the Forest Supervisor, District Ranger, and Fire Staff Officer) to keep the committee informed of the status and potentials of any given fire in the study area. Once a fire is under observation, the Fire Control Officer and Dispatcher will monitor fires on a daily flight basis; and recommend when the Fire Management Committee convenes to discuss special fire management situations. The Committee, or delegated representatives, can order a fire suppressed or direct other fire management activities which will contain the fire within the study area and meet the basic assumptions of the fire management plan. Exceptions to the fire management plan could take place under special fire conditions ("red flag" weather forecasts, endangering public safety or property); under these conditions alternative action plans would be formulated.

6. Portions of the study area are seen by Nezperce and Bitterroot lookouts. The Nezperce lookouts have a radio link with the Bitterroot radio unit. Smoke from the study area could be monitored by several other lookouts.
7. Fire-weather forecasts would be obtained for specific fires. Fire-behavior specialists are available from the Regional Office, Northern Forest Fire Laboratory, and Bitterroot National Forest.

Other preattack considerations on a zone-by-zone basis are:

Shrubfield Zone

1. Fires will be suppressed along the west boundary of the shrubfield zone to contain within the study area.
2. Fires will be suppressed during the hunting season to meet human safety requirements. These fires will receive direct attack. If direct attack fails, the next effort will be on predetermined lines indicated on the map.
3. Fires spreading into the Douglas-fir/ponderosa pine zone in Wapiti Creek will be attacked from the Wapiti Creek side--two deep saddles along that divide and the ridge just north of Bad Luck Lookout are poor barriers to fire spread.

Ponderosa Pine Savanna

1. Zone boundaries are good fire control boundaries. Additional interior lines suitable for control are indicated on the preattack map (see Appendix).

Ponderosa Pine/Douglas-fir South Slope Zone

1. Fire above 4,500 feet elevation will be suppressed along predetermined lines so one fire does not spread through more than one side of the drainage.
2. Fires below 4,500 feet will receive aggressive initial attack --if initial attack fails, the predetermined lines may be used to affect control.

North Slope Communities Zone

1. Fires burning to or starting on study area boundaries will be suppressed along the boundary.
2. Preattack lines in Peach Creek have been identified to meet the prescriptions for BUI's greater than 170.

Subalpine Zone

1. Fires burning to or starting on the study area boundaries will be suppressed along the boundary.
2. When the Hell's Half-Acre Lookout BUI is greater than 170, prepare suppression plan to stop fires in the areas of continuous fuels crossing the study area boundary from the head of Bad Luck Creek to the head of Fry Pan Creek (Moose Creek District) and the low saddles along the Bitterroot Crest (see preattack map in Appendix).

WILDERNESS FIRE MANAGEMENT PLAN

Management Zone	Suppression	Observation	Observation + Suppression
1. Shrubfield	a. Hunting season: BUI >170 b. Along study boundaries	a. Prehunting season b. Hunting season: BUI <170	a. Fires approaching Wapiti Creek Ridge
2. Ponderosa pine savanna		a. BUI <170	a. BUI >170
3. Ponderosa pine/ Douglas-fir	a. <4,500' elevation	a. >4,500' elevation, BUI <170	a. >4,500', BUI >170
4. North slope	a. Along study boundaries b. BUI >170: Peack Creek Drainage	a. West of Peach Creek Drainage b. Upper White Cap unit	a. BUI >170: fires approaching Peach Creek buffer
5. Subalpine	a. Along study boundaries b. BUI >170: Bitterroot Crest passes	a. Season-long	a. BUI >170: fires approaching Bitterroot Crest passes

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APPENDIX

PUBLIC LAW 88-577
88th Congress, S. 4
September 3, 1964

AN ACT

To establish a National Wilderness Preservation System for the permanent good of the whole people, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SHORT TITLE

Section 1. This Act may be cited as the "Wilderness Act."

WILDERNESS SYSTEM ESTABLISHED STATEMENT OF POLICY

SEC. 2. (a) In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas," and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness; and no Federal lands shall be designated as "wilderness areas" except as provided for in this Act or by a subsequent Act.

(b) The inclusion of an area in the National Wilderness Preservation System notwithstanding, the area shall continue to be managed by the Department and agency having jurisdiction thereover immediately before its inclusion in the National Wilderness Preservation System unless otherwise provided by Act of Congress. No appropriation shall be available for the payment of expenses or salaries for the administration of the National Wilderness Preservation System as a separate unit nor shall any appropriations be available for additional personnel stated as being required solely for the purpose of managing or administering areas solely because they are included within the National Wilderness Preservation System.

DEFINITION OF WILDERNESS

(c) A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to

make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

NATIONAL WILDERNESS PRESERVATION SYSTEM--EXTENT OF SYSTEM

SEC. 3. (a) All areas within the national forests classified at least 30 days before the effective date of this Act by the Secretary of Agriculture or the Chief of the Forest Service as "wilderness," "wild," or"canoe" are hereby designated as wilderness areas. The Secretary of Agriculture shall---

(1) Within one year after the effective date of this Act, file a map and legal description of each wilderness area with the Interior and Insular Affairs Committees of the United States Senate and the House of Representatives, and such descriptions shall have the same force and effect as if included in this Act: Provided, however, That correction of clerical and typographical errors in such legal descriptions and maps may be made.

(2) Maintain, available to the public, records pertaining to said wilderness areas, including maps and legal descriptions, copies of regulations governing them, copies of public notices of, and reports submitted to Congress regarding pending additions, eliminations, or modifications. Maps, legal descriptions, and regulations pertaining to wilderness areas within their respective jurisdictions also shall be available to the public in the offices of regional foresters, national forest supervisors, and forest rangers.

(b) The Secretary of Agriculture shall, within ten years after the enactment of this Act, review, as to its suitability or nonsuitability for preservation as wilderness, each area in the national forests classified on the effective date of this Act by the Secretary of Agriculture or the Chief of the Forest Service as "primitive" and report his findings to the President. The President shall advise the United States Senate and House of Representatives of his recommendations with respect to the designations as "wilderness" or other reclassification of each area on which review has been completed, together with maps and a definition of boundaries. Such advice shall be given with respect to not less than one-third of all the areas now classified as "primitive" within three years after the enactment of this Act, not less than two-thirds within seven years after the enactment of this Act, and the remaining areas within ten years after the enactment of this Act. Each recommendation of the President for designation as "wilderness" shall become effective only if so provided by an Act of Congress. Areas classified as "primitive" on the effective date of this Act shall continue to be administered under the rules and regulations affecting such areas on the effective date of this Act until Congress has determined otherwise. Any such area may be increased in size by the President at the time he submits his recommendations to the Congress by not more than five thousand acres with no more than one thousand two hundred and eighty acres of such increase in any one compact unit; if it is proposed to increase the size of any such area by more than five thousand acres or by more than one thousand two hundred and eighty acres in any one compact

unit the increase in size shall not become effective until acted upon by Congress. Nothing herein contained shall limit the President in proposing as part of his recommendations to Congress, the alteration of existing boundaries of primitive areas or recommending the addition of any contiguous area of national forest lands predominantly of wilderness value. Notwithstanding any other provisions of this Act, the Secretary of Agriculture may complete his review and delete such area as may be necessary, but not to exceed seven thousand acres, from the southern tip of the Gore Range-Eagles Nest Primitive Area, Colorado, if the Secretary determines that such action is in the public interest.

(c) Within ten years after the effective date of this Act the Secretary of the Interior shall review every roadless area of five thousand contiguous acres or more in the national parks monuments and other units of the national park system and every such area of, and every roadless island within the national wildlife refuges and game ranges, under his jurisdiction on the effective date of this Act and shall report to the President his recommendation as to the suitability or nonsuitability of each such area or island for preservation as wilderness. The President shall advise the President of the Senate and the Speaker of the House of Representatives of his recommendation with respect to the designation as wilderness of each such area or island on which review has been completed, together with a map thereof and a definition of its boundaries. Such advice shall be given with respect to not less than one-third of the areas and islands to be reviewed under this subsection within three years after enactment of this Act, not less than two-thirds within seven years of enactment of this Act, and the remainder within ten years of enactment

of this Act. A recommendation of the President for designation as wilderness shall become effective only if so provided by an Act of Congress. Nothing contained herein shall, by implication or otherwise, be construed to lessen the present statutory authority of the Secretary of the Interior with respect to the maintenance of roadless areas within units of the national park system.

(d)(1) The Secretary of Agriculture and the Secretary of the Interior shall, prior to submitting any recommendations to the President with respect to the suitability of any area for preservation as wilderness--

(A) give such public notice of the proposed action as they deem appropriate, including publication in the Federal Register and in a newspaper having general circulation in the area or areas in the vicinity of the affected land;

(B) hold a public hearing or hearings at a location or locations convenient to the area affected. The hearings shall be announced through such means as the respective Secretaries involved deem appropriate, including notices in the Federal Register and in newspapers of general circulation in the area: Provided, That if the lands involved are located in more than one State, at least one hearing shall be held in each State in which a portion of the land lies:

(C) at least thirty days before the date of a hearing advise the Governor of each State and the governing board of each county or in Alaska the borough, in which the lands are located, and Federal departments and agencies concerned, and invite such officials and Federal agencies to submit their views on the proposed action at the

hearings or by no later than thirty days following the date of the hearing.

(2) Any views submitted to the appropriate Secretary under the provisions of (1) of this subsection with respect to any area shall be included with any recommendations to the President and to Congress with respect to such area.

(e) Any modification or adjustment of boundaries of any wilderness area shall be recommended by the appropriate Secretary after public notice of such proposal and public hearing or hearings as provided in subsection (d) of this section. The proposed modification or adjustment shall then be recommended with map and description thereof to the President. The President shall advise the United States Senate and the House of Representatives of his recommendations with respect to such modification or adjustment and such recommendations shall become effective only in the same manner as provided for in subsections (b) and (c) of this section.

USE OF WILDERNESS AREAS

Sec. 4. (a) The purposes of this Act are hereby declared to be within and supplemental to the purposes for which national forests and units of the national park and national wildlife refuge systems are established and administered and--

(1) Nothing in this Act shall be deemed to be in interference with the purpose for which national forests are established as set forth in the Act of June 4, 1897 (30 Stat. 11), and the Multiple-Use Sustained Yield Act of June 12, 1960 (74 Stat. 215).

(2) Nothing in this Act shall modify the restrictions and provisions of the Shipstead-Nolan Act (Public Law 539, Seventy-first Congress, July 10, 1930; 46 Stat. 1020), the Thye-Blatnik Act (Public Law 733, Eightieth Congress, June 22, 1948; 62 Stat. 568), and the Humphrey-Thye-Blatnik-Andresen Act (Public Law 607, Eighty-fourth Congress, June 22, 1956; 70 Stat. 326), as applying to the Superior National Forest or the regulations of the Secretary of Agriculture.

(3) Nothing in this Act shall modify the statutory authority under which units of the national park system are created. Further, the designation of any area of any park, monument, or other unit of the national park system as a wilderness area pursuant to this Act shall in no manner lower the standards evolved for the use and preservation of such park, monument, or other unit of the national park system in accordance with the Act of August 25, 1916, the statutory authority under which the area was created, or any other Act of Congress which might pertain to or affect such area, including but not limited to, the Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. 432 et seq.); section 3(2) of the Federal Power Act (16 U.S.C. 796 (2); and the Act of August 21, 1935 (49 Stat. 666; 16 U.S.C. 461 et seq.).

(b) Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to

preserve its wilderness character. Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific educational conservation, and historical use.

PROHIBITION OF CERTAIN USES

(c) Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

SPECIAL PROVISIONS

(d) The following special provisions are hereby made:

(1) Within wilderness areas designated by this Act the use of aircraft or motorboats, where these uses have already become established, may be permitted to continue subject to such restrictions as the Secretary of Agriculture deems desirable. In addition, such measures may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable.

(2) Nothing in this Act shall prevent within national forest wilderness areas any activity, including prospecting, for the purpose of gathering information about mineral or other resources, if such activity is carried on in a manner compatible with the preservation of the wilderness environment. Furthermore, in accordance with such program as the Secretary of the Interior shall develop and conduct in consultation with the Secretary of Agriculture, such areas shall be surveyed on a planned, recurring basis consistent with the concept of wilderness preservation by the Geological Survey and the Bureau of Mines to determine the mineral values, if any, that may be present; and the results of such surveys shall be made available to the public and submitted to the President and Congress.

(3) Notwithstanding any other provisions of this Act, until midnight December 31, 1983, the United States mining laws and all laws pertaining to mineral leasing shall, to the same extent as applicable prior to the effective date of this Act, extend to those national forest lands designated by this Act as the "wilderness areas;" subject, however, to such reasonable regulations governing ingress and egress as may be prescribed by the Secretary of Agriculture consistent with the use of the land for mineral location and development and exploration, drilling, and production, and use of land for transmission lines, water-lines, telephone lines, or facilities necessary in exploring, drilling, producing, mining, and processing operations, including where essential the use of mechanized ground or air equipment and restoration as near as practicable of the surface of the land disturbed in performing prospecting, location, and, in oil and gas leasing, discovery work, exploration, drilling, and production, as soon as they have served their purpose. Mining locations

lying within the boundaries of said wilderness areas shall be held and used solely for mining or processing operations and uses reasonably incident thereto: and hereafter, subject to valid existing rights, all patents issued under the mining laws of the United States affecting national forest lands designated by this Act as wilderness areas shall convey title to the mineral deposits within the claim, together with the right to cut and use so much of the mature timber therefrom as may be needed in the extraction, removal, and beneficiation of the mineral deposits, if needed timber is not otherwise reasonably available, and if the timber is cut under sound principles of forest management as defined by the national forest rules and regulations, but each such patent shall reserve to the United States all title in or to the surface of the lands and products thereof, and no use of the surface of the claim or the resources therefrom not reasonably required for carrying on mining or prospecting shall be allowed except as otherwise expressly provided in this Act: Provided, That, unless hereafter specifically authorized, no patent within wilderness areas designated by this Act shall issue after December 31, 1983, except for the valid claims existing on or before December 31, 1983. Mining claims located after the effective date of this Act within the boundaries of wilderness areas designated by this Act shall create no rights in excess of those rights which may be patented under the provisions of this subsection. Mineral leases, permits, and licenses covering lands within national forest wilderness areas designated by this Act shall contain such reasonable stipulations as may be prescribed by the Secretary of Agriculture for the protection of the wilderness character of the land consistent with

the use of the land for the purposes for which they are leased, permitted, or licensed. Subject to valid rights then existing, effective January 1, 1984, the minerals in lands designated by this Act as wilderness areas are withdrawn from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral leasing and all amendments thereto.

(4) Within wilderness areas in the national forests designated by this Act (1) the President may, within a specific area and in accordance with such regulations as he may deem desirable, authorize prospecting for water resources, the establishment and maintenance of reservoirs, water conservation works, power projects, transmission lines, and other facilities needed in the public interest, including the road construction and maintenance essential to development and use thereof, upon his determination that such use or uses in the specific area will better serve the interests of the United States and the people thereof than will its denial; and (2) the grazing of livestock, where established prior to the effective date of this Act, shall be permitted to continue subject to such reasonable regulations as are deemed necessary by the Secretary of Agriculture.

(5) Other provisions of this Act to the contrary notwithstanding, the management of the Boundary Waters Canoe Area, formerly designated as the Superior, Little Indian Sioux, and Caribou Roadless Areas, in the Superior National Forest, Minnesota, shall be in accordance with regulations established by the Secretary of Agriculture in accordance with the general purpose of maintaining, without unnecessary restrictions on other uses,

including that of timber, the primitive character of the area, particularly in the vicinity of lakes, streams, and portages: Provided, That nothing in this Act shall preclude the continuance within the area of any already established use of motorboats.

(6) Commercial services may be performed within the wilderness areas designated by this Act to the extent necessary for activities which are proper for realizing the recreational or other wilderness purposes of the areas.

(7) Nothing in this Act shall constitute an express or implied claim or denial on the part of the Federal government as to exemption from State water laws.

(8) Nothing in this Act shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish in the national forests.

STATE AND PRIVATE LANDS WITHIN WILDERNESS AREAS

Sec. 5. (a) In any case where State-owned or privately owned land is completely surrounded by national forest lands within areas designated by this Act as wilderness, such State or private owner shall be given such rights as may be necessary to assure adequate access to such State-owned or privately owned land by such State or private owner and their successors in interest, or the State-owned land or privately owned land shall be exchanged for federally owned land in the same State of approximately equal value under authorities available to the Secretary of Agriculture: Provided, however, That the United States shall not transfer to a State or private owner any mineral interests unless the State or private owner relinquishes or causes to be relinquished to the United States the mineral interest in the surrounded land.

(b) In any case where valid mining claims or other valid occupancies are wholly within a designated national forest wilderness area, the Secretary of Agriculture shall, by reasonable regulations consistent with the preservation of the area as wilderness, permit ingress and egress to such surrounded areas by means which have been or are being customarily enjoyed with respect to other such areas similarly situated.

(c) Subject to the appropriation of funds by Congress, the Secretary of Agriculture is authorized to acquire privately owned land within the perimeter of any area designated by this Act as wilderness if (1) the owner concurs in such acquisition or (2) the acquisition is specifically authorized by Congress.

GIFTS, BEQUESTS, AND CONTRIBUTIONS

Sec. 6. (a) The Secretary of Agriculture may accept gifts or bequests of land within wilderness areas designated by this Act for preservation as wilderness. The Secretary of Agriculture may also accept gifts or bequests of land adjacent to wilderness areas designated by this Act for preservation as wilderness if he has given sixty days advance notice thereof to the President of the Senate and the Speaker of the House of Representatives. Land accepted by the Secretary of Agriculture under this section shall become part of the wilderness area involved. Regulations with regard to any such land may be in accordance with such agreements, consistent with the policy of this Act, as are made at the time of such gift, or such conditions, consistent with such policy, as may be included in, and accepted with, such bequest.

(b) The Secretary of Agriculture or the Secretary of the Interior is authorized to accept private contributions and gifts to be used to further the purposes of this Act.

ANNUAL REPORTS

Sec. 7. At the opening of each session of Congress, the Secretaries of Agriculture and Interior shall jointly report to the President for transmission to Congress on the status of the wilderness system, including a list and descriptions of the areas in the system, regulations in effect, and other pertinent information, together with any recommendations they may care to make.

APPROVED SEPTEMBER 3, 1964.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 1538 accompanying H. R. 9070 (Comm. on Interior & Insular Affairs) and No. 1829 (Comm. of Conference).

SENATE REPORT No. 109 (Comm. on Interior & Insular Affairs).

CONGRESSIONAL RECORD:

Vol. 109(1963): Apr. 4, 8, considered in Senate.
Apr. 9, considered and passed Senate.

Vol. 110 (1964): July 28, considered in House.
July 30, considered and passed House, amended, in lieu of H. R. 9070.
Aug. 20, House and Senate agreed to conference report.

Analysis of Fires Occurring in the White Cap
Study Area from 1926 through 1970 - 212 Fires

Prepared
By
W. L. DeZell

Lightning caused 206 of the 212 fires, or 97 percent. Of the other six fires, five were caused by careless smoking and one resulted from a hunter's cooking fire. Fifty-eight class "B" and larger fires burned 1,247 acres; man-caused fires burned 23.5 of these acres.

Fires in the study area occurred in the 6 months from May through October. Most of the fires occurred in July, August, and September.

	Percent of Occurrence		
Month	All fires	Class B & Larger	Class C,D, & E
May	1.4%	3%	15%
June	5.2%	5%	8%
July	35.8%	33%	46%
August	40.5%	30%	8%
September	15.1%	26%	15%
October	2 %	3%	8%
Total Fires	212	58	13

Fire occurrence ranged from a high of 19 in 1961 to 5 years in which there were no fires suppressed in the study area. The average number of fires in the area for the 45 years was 4.7. Analysis of the number of fires by individual years indicates the following:

In 19 of the 45 years (42%) there were 2 fires or less.

In 20 of the 45 years (44%) there were from 3 to 8 fires.

In 6 of the 45 years (14%) there were from 9 to 19 fires.

The earliest fire occurrence for the study period was May 13; the fire was a Class C and burned 90 acres. The latest fire occurrence was October 10, a Class B, man-caused fire which burned 3.5 acres. Multiple fire occurrence is frequent with as many as 9 fires starting in 1 day on September 3, 1942. There were several days when over 6 fires started.

Fires occurred at nearly all elevations. Larger fires tend to occur at lower elevations, with lower occurrence of larger fires in the 5,001 to 7,000-foot range as follows:

Elevation Range	Percent of All Fires	Percent of Class B & Larger	Percent of Class C, D, & E
3,000-4,000	6.1%	10.3%	23.0%
4,001-5,000	25.0%	24.1%	31.0%
5,001-6,000	14.1%	10.3%	8.0%
6,001-7,000	26.4%	22.5%	8.0%
7,001-8,000	23.2%	22.5%	15.0%
8,000+	5.2%	10.3%	15.0%
Number of Fires	212	58	13

We evaluated the time from origin to discovery and arrived at the following table:

Time from Origin to Discovery	Percent of All Fires	Percent of Class B & Larger	Percent of Class C, D, &E
0- 2 Hours	31.0%	20.0%	15.0%
2- 4 Hours	9.0%	7.0%	8.0%
4- 8 Hours	4.7%	4.0%	8.0%
8-24 Hours	24.5%	24.0%	31.0%
24-48 Hours	12.3%	14.0%	15.0%
48 Hours +	18.5%	31.0%	23.0%
Number of Fires	212	58	13

Fires were discovered by lookouts and other Forest Service employees with the air patrol becoming a major detection factor in more recent years. There were no fires reported by the general public in the 45-year period analyzed.

Because of the changes in fire report forms, we were unable to establish the position on slope of 60 fires. The following percentage figures apply to those analyzed:

Base or lower 1/3.....10%)
Middle 1/3.....43%) - 152 fires
Upper 1/3 or Top.....47%)

A comparison of the exposure fires occur as follows:

Exposure	Percent of All Fires	Percent of Class B & Larger	Percent of Class C, D, & E
N	10.0%)	7.0%)	8.0%)
NE	4.0%) - 23%	2.0%) - 16%	0.0%) - 8%
NW	9.0%)	7.0%)	0.0%)
S	27.0%)	29.0%)	23.0%)
SE	11.0%) - 56%	10.0%) - 63%	15.0%) - 69%
SW	18.0%)	24.0%)	31.0%)
E	9.0%)	7.0%)	0.0%)
W	11.0%) - 21%	13.0%) - 21%	15.0%) - 23%
Valley Bottom	1.0%)	1.0%)	8.0%)

Prevailing winds in the study area are from the southwest and may be a factor in larger fire occurrence on Southwest slopes.

Evaluation of steepness of slope in relation to fire size:

Slope	All Fires	Class B & Larger	Class C, D, & E
0-20%	14%	5%	8%
21-40%	18%	17%	16%
41-60%	21%	26%	8%
61-80%	24%	24%	30%
81% +	22%	28%	38%
	212 Fires	58 Fires	13 Fires

Two things we wanted to consider but could not because of changes in fire records were fuels at point of origin and fire danger. Fuels at point of origin are not on the older individual fire reports. Fire danger ratings were either not shown or were expressed in a different form.

DESCRIPTIONS OF LANDFORMS IN THE WHITE CAP CREEK DRAINAGE
By Robert C. Malmgren, Soil Scientist
Bitterroot National Forest

1. Well Dissected, South Breaklands

Landform Characteristics - Low to very low elevational range on chiefly southerly to westerly aspects, modified by the action of major streams degrading at a more rapid rate than the adjoining slopes could retreat. Elevational range is largely between 3,000 and 5,000 feet.

Local relief is very high and slope gradients range from 60 to 80 percent. Stream development ranges from very closely laterally spaced to moderately spaced laterally first order drainageways which are moderately-well entrenched to fully entrenched. They have relatively short reaches where stream ordering is not normal; first order streams are abnormally long. Second and third order drainageway densities range from relatively closely spaced to relatively very widely spaced. Overland flow is very common. This unit is of moderate extent in the study area.

Soils - The soils of this unit are usually shallow, well- to excessively-drained, friable, non-plastic, rapid to very rapidly permeable. They have a loamy sand to sandy loam surface texture and a loamy sand subsoil. Coarse fragments vary from 20-50 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic gneiss, or ortho-gneissic. Locally, grus may be found near or at the surface in this unit.

2. Moderately Dissected, South Breaklands

Landform Characteristics - These characteristics are very similar to those of unit number 1, except stream development is not as closely spaced. Slope gradients range from 50-70 percent. This unit has an elevational

range of from 3,000 to 6,000 feet, with the largest area in the 4,000 to 5,000-foot zones. Overland flow is common.

Soils - The soils of this unit are usually shallow, well- to excessively-drained, friable, non-plastic, rapid to very rapidly permeable. They have a sandy loam surface texture and a loamy sand subsoil. Coarse fragments vary from 20-50 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic-gneiss, or ortho-gneissic. Locally, grus may be found near or at the surface in this unit.

3. Stream Deposition

This unit has developed from local alluvium at the base of steeper slopes as well as deposition during flood stage of larger streams. Dissection may be quite prevalent on the border of these units where they have received runoff from the adjacent landforms. This unit is of minor extent in the study area.

Soils - The soils of this unit have a range from shallow to deep with the most dominant being deep. They are well-drained to imperfectly-drained, non-plastic, and rapidly permeable. They have a sandy loam surface texture and a sandy loam to sand subsoil. Coarse fragment content varies from 10-60 percent by volume. The bedrock is undifferentiated, chiefly granitic or granitic-gneiss, or ortho-gneissic.

5. Undissected, North Breaklands

Landform Characteristics - Steep to very steep lands adjacent to large order streams on northerly aspects modified to some extent by the action of surface runoff, but primarily they were a product of streams degrading at a faster rate than the adjoining slopes could retreat. Elevational range

is largely between 3,500 and 5,000. Local relief is very high and slope gradient ranges from 60-80 percent. Stream development is variable, but for the most part, they are widely-spaced with slight to moderate entrenchment. Second order streams are common and third order streams are rare. Overland flow is rare. This unit is moderately extensive in the survey area.

Soils - The soils of this unit are usually shallow, well- to excessively-drained, friable, non-plastic, rapid to very rapidly permeable. They have a sandy loam surface texture and a loamy sand to sandy loam subsoil. Coarse fragments vary from 20-50 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic-gneiss, or ortho-gneissic. Locally, grus may be found near or at the surface of this unit.

6. Dissected, North Breaklands

Low to moderate elevational range on chiefly northerly to easterly aspect. These units have been modified by the action of major streams degrading at a more rapid rate than the adjoining slopes could retreat. Elevational range is large, between 4,000 to 5,500 feet.

Local relief is very high and slope gradients range from 60 to 80 percent. Stream development ranges from very closely laterally spaced to moderately spaced first order drainageways which are moderately to fully entrenched. They have relatively short reaches where stream ordering is normal; but where it is not normal, first order streams are abnormally long. Second and third order drainageway densities range from relatively closely spaced to very widely spaced. Overland flow is common. This unit is of moderate extent in the study area.

Soils - The soils of this unit are usually shallow, well- to excessively-drained, friable, non-plastic, rapid to very rapidly permeable. They have a sandy loam surface texture with a sandy loam to loamy sand subsoil. Coarse fragments vary from 20-50 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic gneiss, or ortho-gneissic. Locally, grus may be found at or near the surface in this unit.

7. Weak Cryoplanation

Landform Characteristics - Moderately steep to steep slopes on northerly aspects at lower elevational zone and on southerly aspects at moderately high elevational zones. This unit has been modified by subsurface frost action and frost churning and to a much lesser degree, by running water. Elevation range is largely from 6,000 to 7,000 feet. Overall topographic features are moderately soft, local relief is moderately high, and slope gradients range from 40-60 percent. First order streams are widely-spaced with slight entrenchment and have very long reaches. Second and third order streams are very widely-spaced, moderately entrenched, and have very long reaches. Overland flow is relatively rare. This unit is moderately extensive and occurs in relatively large-sized units.

Soils - These soils are moderately deep, well-drained, friable, non-plastic, and rapidly to very rapidly permeable. They have a sandy loam surface texture with a sandy loam to loamy sand subsoil. Coarse fragments range from 20-40 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic gneiss, or ortho-gneissic.

8. Late Mature Pluvial

Landform Characteristics - Steep slopes at lower to middle elevational zones typically on south and westerly aspects, modified chiefly by the action of running water. Topographic features are somewhat sharp, local relief is very high with slope gradients ranging from 50-70 percent. Low order streams typically are closely-spaced. This unit is very extensive in the study area.

Soils - These soils have a range in depth from deep to shallow. They are well-drained, friable, non-plastic, and rapidly to very rapidly permeable. They have a sandy loam surface texture with a loamy sand to sandy loam subsoil. Coarse fragments range from 30-50 percent by volume. The bedrock is hard and undifferentiated, chiefly granitic, granitic-gneiss, or orthogneissic. Locally, grus may be found at or near the surface in this unit.

9. Grussic Cryoplanated

Landform Characteristics - Medium elevations (5,000-6,500 feet) on south aspects, modified by subsurface frost churning and subsequent sheet erosion. Overall topographic features are soft, local relief is low to moderate, and slope gradients range from 40-60 percent. First order drainageways are very widely-spaced. Overland flow is common, but not concentrated. This unit is not extensive in the study area.

Soils - These soils are shallow. They are well-drained, friable, non-plastic, and rapidly to very rapidly permeable. They have a sand loam surface texture and a sandy loam to loamy sand subsoil. Coarse fragments range from 30-50 percent by volume. The bedrock is commonly soft, being of granitic or granitic-gneiss in origin. Grus near the surface is quite common in this unit.

10. Thick Mantle, Strong Cryoplanation

Landform Characteristics - Medium to high elevation slopes (6,000-7,500 feet) and broad ridgetops strongly modified by intensive frost action on subsurface, frost churning, and glacial deposits. Overall topographic features are soft, local relief is low to moderate, and slope gradients range most commonly from 20-40 percent. First order stream drainageways typically are very widely-spaced, very shallow entrenched, and have very long reaches. Second order streams are wider-spaced, and third order are rare. Overland flow is practically nonexistent. This unit is quite extensive in the study area.

Soils - These soils are deep, well-drained, friable, non-plastic, and rapidly permeable. They have a silt loam surface (loess cap ranging in depth from 2 to 6 inches) overlying a sandy loam to loam subsoil. In smaller areas, a loamy sand subsoil texture may be encountered. Coarse fragments range from 40-70 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, or ortho-gneissic.

11. Scoured Valley Trough Wall (South)

Landform Characteristics - Steep to very steep slopes on southerly aspects at moderate to high elevation zones, formed by glacial scouring. Local relief is high and slope gradient is over 60 percent. Drainage characteristics are quite variable, ranging from virtually none to closely-spaced first order streams. Overland flow is common. This unit is of minor extent in the study area.

Soils - The soils on this unit are shallow, well-drained, non-plastic, and rapidly permeable. They have a sandy loam surface soil and a loamy

sand to sandy loam subsoil. Coarse fragment content ranges from 20-40 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, or ortho-gneissic.

12. Valley Trough Wall (North)

Landform Characteristics - Very steep slopes on northerly aspects at moderate to high elevations. The drainage patterns on these lands are typically parallel. Slopes are smooth and weakly dissected with widely-spaced first order streams. Overland flow is common. While this unit is more extensive than Unit No. 11, it is actually moderately extensive.

Soils - The soils on this unit are moderately deep to shallow, well-drained, non-plastic, and rapidly permeable. They have a sandy loam surface soil and a sandy loam to loamy sand subsoil. Coarse fragment content ranges from 20-40 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, and ortho-gneissic.

13. Thin Mantle, Strong Cryoplanation

Landform Characteristics - Moderately high to high upper slopes and ridgetops, modified chiefly by very intensive frost action or subsurface frost churning. Overall topographic features are very soft and local relief very low. Slope gradients range mostly from 20-50 percent. Surface drainageways are essentially lacking (very widely-spaced). Overland flow is very minimal. This unit is moderately extensive in the study area.

Soils - The soils on this unit are deep, well-drained, non-plastic, and rapidly permeable. They have a silt loam surface soil with a sandy loam to loamy sand subsoil. Coarse fragment content ranges from 30-50 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, and ortho-gneissic.

14. Stream Headlands, Undissected, Cryoplanated

Landform Characteristics - This unit occupies the heads of certain small drainages in cryoplanated areas. These lands have been strongly modified by very intensive frost action and subsurface frost churning. Slopes range from 20-60 percent. Elevations range from 5,500 to 7,000 feet. This unit is of very minor extent in the study area.

Soils - The soils on this unit range from deep to shallow, well-drained, non-plastic, and rapidly permeable. They have a sandy loam surface soil with a sandy loam to loamy sand subsoil. Coarse fragment content ranges from 20-40 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, and ortho-gneissic.

15. Very Steep Cryoplanated Uplands

Landform Characteristics - This unit is largely in the upper midslopes (5,000 to 6,500-foot elevation) primarily on north aspects. The unit has been modified by intensive frost action and subsurface frost churning. Overland flow is rare.

Soils - The soils on this unit are deep, well-drained, nonplastic, and rapidly permeable. They have a loam to silt loam surface soil with a sandy loam to loamy sand subsoil. Coarse fragment content ranges from 30-50 percent by volume. The bedrock is undifferentiated, chiefly granitic, granitic-gneiss, and ortho-gneissic.

16. Thin Not Scoured Valley Trough Wall (South)

Landform Characteristics - This unit occupies the steep sideslopes of the glacial troughs occurring largely at elevations of 5,200 to 7,000 feet. Slope gradients range from 60-80 percent. Slopes are generally smooth, being only weakly dissected by parallel drainages. Overland flow is minimal. This unit is moderately extensive in the study area.

Soils - The soils on this unit are shallow to moderately deep, well-drained, non-plastic, and rapidly permeable. They have a sandy loam surface soil and a loamy sand subsoil. Coarse fragment content ranges from 40-60 percent by volume.

17. Valley Moraine

Landform Characteristics - This unit occupies the bottom and lower sideslopes of larger valleys of glacial origin. Included in this unit are small alluvial fans, colluvial toe-slopes, and moraine remnants. Elevation ranges from 4,000 to above 7,000 feet. Slopes range from 0-20 percent. This unit is moderately extensive in the survey area.

Soils - The soils of this unit range from shallow to deep. They are well-drained to somewhat poorly-drained, non-plastic to slightly plastic, friable, moderately rapid to very rapidly permeable. Subsurface textures range from gravelly loamy sand to loam and silty clay loam.

18. Well Scoured Glacial Uplands, 50% + Talus or Outcrop

Landform Characteristics - This unit occupies the moderately steep to very steep slopes at the higher elevations (7,000 to 8,000 feet). Slope gradients range from 40-70 percent. Slope surfaces range from smooth to weakly dissected. This unit is moderately low in extent, but commonly occurs in large areas wherever it is found.

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Soils - The soils on this unit are shallow, well-drained, non-plastic, and rapidly permeable. They have a sandy loam surface texture and a sandy loam to loamy sand subsoil. Coarse fragment content is extremely variable.

19. Extremely Stony North Trough Walls, Thin

Landscape Characteristics - This unit occupies some of the higher ridges and upper slopes in the glaciated areas of the survey area. Elevations are generally above 7,000 feet. Dissection is weak to moderate. The prevalence of loose stone on the surface is one of the dominant features of this unit.

Soils - The soils on this unit are shallow, well-drained, non-plastic, and readily permeable. They have a sandy loam to loamy sand surface texture and subsoil textures. Coarse fragment content is extremely variable.

STREAM CHANNEL CONDITION SURVEY IN WHITE CAP DRAINAGE
By James Eggleston, RO Hydrologist
Region One

Stream Channel Condition

Stream channels in the study area were evaluated for stability using the method developed by Dale Pfankuch which is in use throughout Region 1. This method evaluates various parameters of the streambank, channel bank and bottom, and bank vegetation to arrive at a combined stability rating for a given stream channel. The normal procedures would be to utilize the rating system for all streams on an entire Forest, in which case numerical ratings would be compared for relative stability. Since these six streams were the only ones to be rated on this Forest by the author, numerical ratings were not given. Instead, the streams were rated only for their individual ability to withstand an increase in streamflow without being damaged to an "unacceptable" degree. Off-site, or downstream, damage potential is also considered. This included an evaluation of the present stability, as well as an evaluation of the amount of debris in the channel that could become part of a debris load at higher flows, and the ability of the banks above the existing high water levels to withstand erosion and damage if the peak flows should be increased. Increase in the average annual flow was used for the calculations. However, this includes the peak flows since most of the increase in average annual flows will be produced during the peak flow period.

The streams were evaluated near their mouth only, primarily because of lack of time to follow them upstream for any distance. It is felt that the condition near the mouth is an integration of the factors acting on that stream throughout its length, and is representative of the average condition throughout the stream.

Three streams tributary to White Cap Creek, White Cap Creek, one stream tributary to the Selway River, and the Selway River, were evaluated for channel stability. Lookout Creek and Fox Creek (tributaries to White Cap Creek), White Cap Creek, and the Selway River are all very stable under present conditions. Clift Creek, also a tributary to White Cap Creek, is in fair to good condition, and Bad Luck Creek, a tributary to the Selway River, is in poor condition from a stability standpoint.

The Bad Luck Creek drainage was burned rather severely about 1919. The existing channel is a result of the burn, and shows the effects of increased streamflow and scouring. Although the banks are relatively stable, lateral cutting has taken place with the higher flows. The widened channel has now begun to stabilize with vegetation on the banks and with recovery of vegetation within the watershed. This bank vegetation has tended to choke the channel as peak flows have decreased, and the existing channel cannot stand a recurrent increase in flows without receiving in-channel damage. However, since the total vegetation recovery within the watershed has been rather slight, additional damage to the channel would be insignificant. The greatest

damage from increased flows in Bad Luck Creek would be the inflow of sediment directly into the Selway River. This damage would only be temporary, but it would be a nuisance, and could cause a temporary loss of some spawning gravels. This channel should receive no increase in flows.

White Cap Creek contains about one-fifth of the drainage of the Selway River down to this point. This is a significant portion of the drainage, which is beneficial to our needs. A drainage of this size is sufficient to absorb many "punches" from its tributaries without passing any of the shock on to the Selway River. This will be true as long as the White Cap Creek channel remains stable. This channel should remain stable with an increase in average annual flows of up to 15 percent. However, this channel is more stable than the tributary channels, so the tributary channels become the controlling factor.

As was already mentioned, the Lookout Creek and Fox Creek channels are in good condition stability-wise. However, because of the steeper gradients on the lower portions of these, and similar drainages, increased flows are more apt to cause in-channel scouring and deposition in White Cap Creek. Increased flows in these tributaries with better channel condition should be limited to an 8-10 percent increase.

Clift Creek Channel is in poorer condition, primarily because of the roughness of the channel. Large boulders and debris make up a large portion of the channel and reduce the cross-sectional area. Existing high water flows are forced into overflow channels, although little in-channel erosion has occurred, even in the overflow channels. Clift Creek does not presently have a good timber cover, and it probably never did. It appears to be a typical "high-country" watershed--very rocky, lower vegetation predominates, and runoff is flashy. Flows should not be increased in this drainage by more than 5 percent; but even complete burning in this watershed would not add significantly to the peak flows. This watershed is typical of a transition between the lower, tree-covered slopes, and the higher, rocky and barren slopes.

Increased Flow Analysis

The basis for allowable increases in flows was previously described. The calculations for determining how much of the drainage can be burned over follow. These calculations utilize the formula:

$$ECA = \frac{(A)(I)}{(F)(R)} \text{ :where}$$

ECA = Equivalent clearcut area (or burned area)
A = Average annual water yield, in acre-feet
I = Increase limit for average annual yield, in percent
F = On-site water yield increase factor, in percent
R = Average runoff of treated area, in feet
DA = Drainage area, in acres

$\frac{ECA}{DA}$ = Percent of drainage that can be treated (burned)

PHYSICAL CHARACTERISTICS OF SELECTED WATERSHEDS FOR

Wilderness Fire Study

Drainage	DA Acres	A* Ac.-Ft.	I %	F %	R Feet	ECA÷DA %	Amount That Can be Burned
Bad Luck Ck.	7,904	11,530	0	10	1.46	0	
Lookout Ck.	9,254	23,970	10	45	2.59	22	
Fox Ck.	998	2,230	10	45	2.24	22	
Clift Ck.	2,400	7,660	5	30	3.19	17	
White Cap Ck.	94,700	227,300	15	40	2.40 Est.	37	Estimated, can be worked out if needed.

*From runoff map

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Conclusions

The analysis done for this study was limited both in scope and in area. However, the results do show that these drainages, with the exception of Bad Luck Creek, can be burned to varying degrees without causing excessive in-channel or off-site (downstream) damages. The amount that can be burned varies from 0 percent to 22 percent on the drainages studied. Drainages with similar channel conditions and vegetative cover will have similar percent of area that can be burned. Figures were estimated for White Cap Creek itself because of the shape of the study area. More accurate figures can be determined at a later time if needed. Since the tributary channels are more restrictive than the main White Cap Creek, the percents that can be burned in the tributaries are more critical than for the whole drainage system.

It is important to note that average runoff values, R, are taken for the entire subwatershed. Normally this value would be specified for given elevations, but since wildfire starts or burns cannot be controlled or predicted by elevation zones, an average must be used. In use, this allows some latitude. If a fire starts at a low elevation, and is expected to burn out while still at low elevations, the amount of the drainage that can be burned can be increased because the actual water yield is less than the average used in the computations. Conversely, those fires confined to the higher elevations will yield more water than the average, so less acreage should be burned to maintain good channels.

This analysis does not take into account the debris that may be available for clogging the stream channels, should a fire occur. It is based only on increased yields, primarily from a reduction of evapotranspiration and interception. Debris in itself, if not removed from the channels, can cause channel scouring, debris dams, mudslides, etc. Should the decision be made to let a fire burn itself out, provisions may have to be made for channel clearing. This will depend on the intensity of the fire and the fuel type.

Neither do the calculations, as presented, take soils on the slopes adjacent to the channels into effect. If soils are particularly erosive following burning, the percent allowed for burning should be reduced to prevent excessive sedimentation in the streams.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Region 1, Missoula, Montana 59801

REPLY TO: 2630 Habitat
5190 Management

May 31, 1972

SUBJECT: Wilderness Fire Management Study

TO: Forest Supervisor, Bitterroot
Attention: Dave Aldrich

This is a report on a recent Regional Office service trip to the Forest to provide needed technical fisheries assistance for project planning.

On May 16-19, 1972, Stu Burns, Forest Wildlife Biologist, and I were on the Magruder District to observe spring runoff conditions in relation to the steelhead trout spawning run in the Wilderness Fire Management Study area, and the Magruder Corridor.

On May 17, we hiked from Paradise to Cooper's Flat, observing river conditions and wildlife. Wildlife species observed included five deer and six elk in the Paradise vicinity; one elk near Barefoot Creek; one beaver at Paradise; and two red-tailed hawks (nest site) near Baldy Creek. Bear, coyote, bobcat, and mountain lion signs were prevalent along the trail. Two elk and one deer kill, probably by lion, were noted along the trail and probably occurred during the past winter season. Four active beaver cutting sites were noted in the area from Lookout Creek to above Cedar Gulch Creek.

No steelhead trout were observed due to high water conditions. Whitecap Creek could not be crossed at Cooper's Flat because the bridge was washed out. General stream conditions on major drainages observed from the wilderness boundary to Cooper's Flat on May 17 are listed as follows:

Stream	Time	Water Temp. (°F.)	Water Clarity	Estimated Flow (c.f.s.)
Lookout Creek	0945	40	Clear	300
Cedar Gulch	1030	42	Turbid	50
Bearfoot Creek	1215	44	Clear	20
Baldy Creek	1245	42	Clear	15
Whitecap Creek at Cooper's Flat	1300	40	Clear	1200
Canyon Creek at mouth	1300	-	Clear	600

The turbidity of Cedar Gulch Creek is probably due to unstable soil conditions within the watershed. The stream channel above the trail crossing

was sinuous with sluffing slopes and downed timber which could be an indicator of similar conditions in the upstream portion of the watershed. It is possible that the erosion noted here could be magnified by an intensive wildfire in this small drainage. The stability of this watershed should be investigated further.

Observation and evaluation of these streams during spring runoff is worth while in providing an insight to individual watershed stability and water quality conditions. All streams noted appeared to be a function of a stable watershed, except Cedar Gulch as noted above.

A water sample was taken from Whitecap Creek at Paradise and the hydrochemical analysis is shown in Table 1. The present water quality of the creek can be termed as excellent.

Table 1. Whitecap Creek Hydrochemistry Analysis -- May 18, 1972

Time:	1000 hrs.
Flow (est.):	2000-2500 c.f.s.
Temperature:	Air - 48°F.
	Water - 40°F.
Dissolved oxygen:	13 p.p.m.
Carbon dioxide:	Less than 5 p.p.m.
Free acidity:	0.0 p.p.m.
Total hardness:	25 p.p.m.
Alkalinity:	phth 0.0 p.p.m.
	M.O. 34 p.p.m.
pH:	7.0
Turbidity:	0.0
Sulfate:	8 p.p.m.
Chloride:	2.5 p.p.m.
Manganese:	0.03 p.p.m.
Iron:	0.0 p.p.m.
Copper:	0.01 p.p.m.
Fluoride:	0.15 p.p.m.
Specific conductance:	15 micromhos/CM^2 @ 25° C.

Other general observations noted include:

1. Several rock and soil slides of minor nature across trail in areas of steep slopes and trail cuts.

2. Many ground fractures (1/2" to 1" wide and up to 3 feet long) on the trail tread in areas where trail is on steep slope located on a north or northeast aspect. Some sites appeared to be ready to sluff off or slide this spring.

3. Three trail crossings over springs or seeps were in need of minor repairs (corrugated metal pipe culvert in use).

4. Several areas on the trail were in need of water bars to permit water drainage and prevent erosion.

Riparian vegetation was noted along Whitecap Creek from the wilderness boundary to Cooper's Flat. Dominant overstory vegetation was the Thuja plicata-Abies grandis community in this 7-mile stream reach. The commonly associated fascular understory species noted were: willow, Salix spp.; mountain alder, Alnus sinuata; redosier dogwood, Cornus stoleniferus; chokecherry, Prunus virginiana; mountain ash, Sorbus scopulina; bunchberry dogwood, Cornus canadensis; thimbleberry, Rubus parviflorus; Douglas hawthorn, Crataegus douglasii; snowberry, Symphoricarpus albus; currant, Ribes spp.; Rocky Mountain maple, Acer glabrum; thinleaf huckleberry, Vaccinium membranaceum; orange honeysuckle, Lonicera ciliosa; ninebark, Physocarpus malvaceus; oceanspray, Holodiscus discolor; serviceberry, Amelanchier alnifolia; menziesia, Menziesia ferruginea; and kinnikinnick, Arctostaphylos uva-ursi.

This riparian vegetation provides bank stability, shade cover for water temperature control, nutrients, and terrestrial insects to the aquatic fauna and flora. In these riparian zones fire is usually not a serious threat since debris is generally not abundant and damp conditions minimize the danger of a rampant fire. Studies on the effects of fire on riparian vegetation have shown that riparian vegetation sprouts and grows more rapidly and with greater vigor than adjacent upland species.

Riparian vegetation removal could temporarily increase water temperatures in the fire area during a few low-flow seasons. A watershed study in Region 6 has shown a 10° F. increase in water temperature at the 3200-foot elevation (m.s.l.) following a wildfire which burned 25 percent of the drainage basin. The increase in overall Whitecap drainage water temperature following a fire should be within the tolerable limits for fish and aquatic life because of the area elevation (m.s.l.), streamflow, and geomorphic design of the stream channel. Optimum temperatures recommended by the U.S. Fish and Wildlife Service for anadromous fish species, by function, are:

Migration routes	-	45-60°F.
Spawning areas	-	45-55°F.
Rearing areas	-	50-60°F.

Upper temperatures should not exceed 68°F. for salmon and steelhead. Above this limit, disease and mortality can be expected. Temperatures above 62°F. can be expected to be lethal to juvenile salmonids.

While the study area is within the Idaho batholith and contains excellent water quality, the productivity of the water is relatively low in dissolved solids. Organic nutrients in the water are low due to this granitic land form. Fire can provide a means of supplemental nutrients to the aquatic system from terrestrial runoff and filtration through the porous soil. However, it is possible that excessive runoff from a storm following a fire could dump large quantities of ash into a stream system drastically lowering the water's pH. A low pH value, an indicator of acidity, could have adverse and lethal effects on a fishery (adults, juveniles, and eggs) and aquatic bottom fauna and flora. This would probably be of temporary nature, and a system such as the Whitecap and Selway could be expected to flush itself clean rapidly, depending on flow conditions. Conditions could be long lasting, however, in high elevation lakes, in igneous basins, with no outlet for flushing the lake clean. A fishery and aquatic life in this situation could be eliminated or drastically reduced, and recovery time long and slow. Lakes within the study area should be surveyed to determine fishery significance and degree of susceptibility and loss from wildfire.

Nutrient loss from soil surface to the streamflow increased significantly the first and second years following the Entiat wildfire in Washington (August 1970). For example, potassium increased 3 times, and nitrogen increased up to 20 times above normal the second year, but these levels were still low in volume, being about one part per million. A stream's flow regime would provide the dilution factor to regulate the extent of nutrient saturation in an aquatic system, and the Whitecap system is large enough to provide an adequate streamflow for this dilution rate.

A hot slash burn over a clearcut area in the H. J. Andrews Experimental Forest, Oregon, showed significant increases in individual dissolved chemicals in the streamflow, but most declined during the 12 days following the burn. Only concentrations of ammonia and manganese exceeded maximum permissible levels (F.W.Q.A. 1970). Similar characteristics were also noted in the Alsca watershed study, Oregon.

5.

While some work has been done concerning the importance of the addition of nutrients to the aquatic stream system, much more research is needed. The importance of soil nutrient loss, such as dissolved nutrients in connection with sediment, particularly needs further investigation.

Land erosion, permitting excessive sediment (bedload sediment, suspended sediment, and turbidity) above the natural level for a prolonged period to be introduced into the aquatic system, could have lethal effects on aquatic life by filling in gravel spawning areas, rearing and resting pools, and eliminating aquatic insect producing areas. Due to the nature of the granitic land mass in the Whitecap Creek drainage, sediment particle sizes for materials less than 6.35 mm (1/4 inch) are quite significant. No gravel analysis has been done in the Whitecap Creek area to date, although some sampling is scheduled for F.Y. 1973 during the September chinook salmon run. However, gravel sampling has been done on the upper Selway River above Whitecap Creek, which can be compared to the study area quite readily. Gravel analysis collected each year to date since 1968 indicates the Selway River has granitic particle sizes less than 6.35 mm amounting to about 34 percent of the total bedload in spawning gravel areas. Fine sediment less than 0.84 mm consists of about 10 percent. These figures indicate sediment composition in gravels under natural conditions in relatively undisturbed drainage system.

The South Fork Salmon River has been badly damaged by sediment from man's land use activities. The percent of fine sediment less than 0.84 mm in this system was 47 percent. This amount was the primary limiting factor for reducing the anadromous fishery in the South Fork nearly to the point of elimination.

Fire is a natural phenomenon and can certainly be considered a cause of introducing additional sediment into an aquatic system. However, in the long run, sediment resulting from fire caused erosion would probably not be in significant quantities of long-term duration to drastically alter the aquatic ecosystem. This is one gray area, as far as data collection and analysis goes, and should be studied intensely in the future by research personnel in fire, soils, hydrology and fisheries. Short term effects of increased sedimentation above the average system levels would probably be noticed but size of the Whitecap drainage and its fluvial hydraulics would be such to flush itself quite rapidly.

The amount of sediment entering the Selway River system could be detrimental to fall chinook salmon spawning success and cause increased egg and fry mortalities. The magnitude of this situation

would probably be governed by the river's hydraulics and the nature of the water year.

Studies in Washington in connection with Entiat watershed have shown that natural ground cover has recovered 10 to 15 percent the first year following the fire. Forest Service hydrologists feel that the degree of soil moisture accumulation in the top four feet of soil is the critical key to the amount of erosion and sedimentation that can be expected to occur. The erosion potential is significantly increased on slope areas greater than 30 percent.

Sediment introduced into the aquatic system, resulting from fire, can also be beneficial by providing additional organic materials or replenishment of nutrients in the streambottom materials to aid in overall productivity of the water which is naturally low to begin with in this area. Fire can then be considered just one of nature's ways of providing a fertilizer or enrichment of an aquatic ecosystem periodically through time.

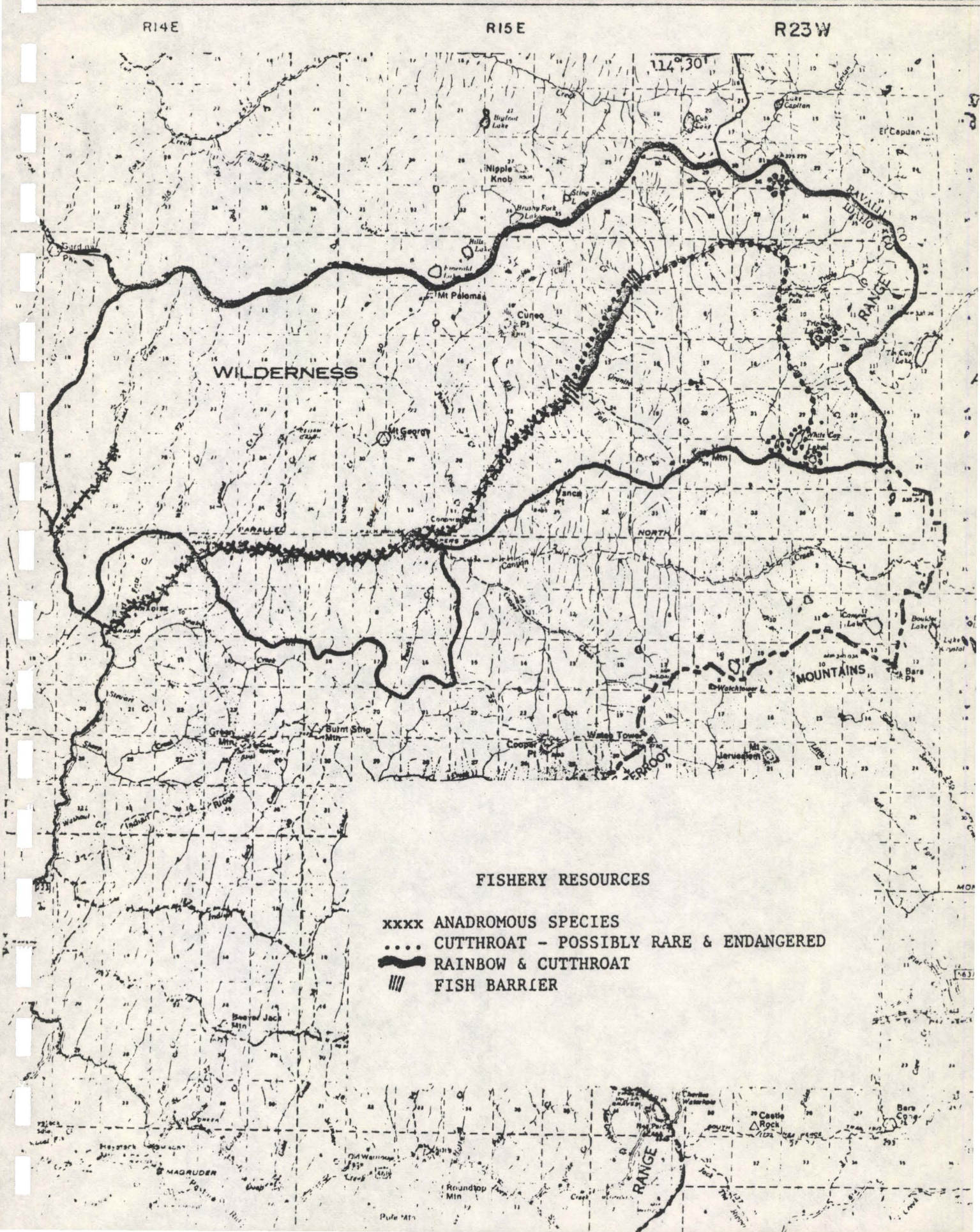
Recovery and stabilization of the aquatic system and terrestrial landform following a fire can generally be expected to proceed at a faster rate than those land and aquatic systems damaged by man's physical alteration of the environment.

I hope this information will be of value to you for your meeting and overall planning schedule. I put this together hastily and it is rather sketchy but I hope to improve on it from subsequent field trips into the Whitecap area to gather additional aquatic data. I will prepare a map listing the various fish species inhabiting the drainage for your planning use. Let me know if I can be of further help to you this field season, or provide assistance in answering any specific questions about aquatic habitat that may result from your meetings and discussions.

/s/ Donald A. Duff

DONALD A. DUFF
Fisheries Biologist
Division of Range and
Wildlife Management

cc: Magruder R.D. (Btr.)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Green Mtn
Cooper Pt
Water Tower
Jerusalem Mt
Nipple Knob
Bluefront Lake
Brushy Fork Lake
Nils Lake
Canyon
Castle Rock
Roundtop Mtn
Old Wallowa
Haystack Mtn
Beaver Jack Mtn
MAGRUDER
FISHERY RESOURCES
xxxx ANADROMOUS SPECIES
.... CUTTHROAT - POSSIBLY RARE & ENDANGERED
RAINBOW & CUTTHROAT
FISH BARRIER

COMMON AND SCIENTIFIC NAMES OF SPECIES CITED IN THE REPORT

SHRUBS

Common name	Scientific name
Alder	*Alnus sinuata*
Bitter Cherry	*Prunus emarginata*
Bunchberry	*Cornus canadensis*
Cascara Buckthorn	*Rhamnus purshiana*
Chokecherry	*Prunus virginiana*
Currant	*Ribes* spp.
Grouse Whortleberry	*Vaccinium scoparium*
Hawthorn	*Crataegus douglasii*
Honeysuckle	*Lonicera utahensis*
Huckleberry	*Vaccinium globulare*
Labrador Tea	*Ledum glandulosum*
Menziesia	*Menziesia ferruginea*
Mock-orange	*Philadelphus lewisii*
Mountain Ash	*Sorbus scopulina*
Mountain Heather	*Phyllodoce empetriformis*
Mountain Maple	*Acer glabrum*
Ninebark	*Physocarpus malvaceus*
Oceanspray	*Holodiscus discolor*
Oregon Grape	*Berberis repens*
Pachistima	*Pachistima myrsinites*
Prince's Pine	*Chimaphila umbellata*

SHRUBS (continued)

Common name	Scientific name
Redosier Dogwood	Cornus stolonifera
Redstem Ceanothus	Ceanothus sanguineus
Rose	Rosa spp.
Serviceberry	Amelanchier alnifolia
Shiny Leaf Ceanothus	Ceanothus velutinus
Snowberry	Symphoricarpos albus
Spiraea	Spiraea betulifolia
Thimbleberry	Rubus parviflorus
Willow	Salix spp.

FORBS

Anemone	Anemone piperi
Arnica	Arnica spp.
Arrowleaf Balsamroot	Balsamorhiza sagittata
Beach Fern	Phegopteris dryopteris
Beargrass	Xerophyllum tenax
Bedstraw	Galium triflorum
Bog Orchid	Habenaria dilatata
Bracken Fern	Pteridium aquilinum
Buttercup	Ranunculus spp.
Cinquefoil	Potentilla spp.
Cirsium	Cirsium arvense

FORBS (continued)

Common name	Scientific name
Clarkia	*Clarkia pulchella*
Clover	*Trifolium* spp.
Death Camas	*Zigadenus elegans*
Dogbane	*Apocynum androsaemifolium*
Fairy Bells	*Disporum hookeri*
Fairy Slipper	*Calypso bulbosa*
Feather Solomon's Seal	*Smilacina racemosa*
Foam Flower	*Tiarella unifoliata*
Geranium	*Geranium viscosissimum*
Goldthread	*Coptis occidentalis*
Harebell (Bluebell)	*Campanula rotundifolia*
Hawkweed	*Hieracium* spp.
Indian Paintbrush	*Castilleja* spp.
Ladyfern	*Athyrium filix-femina*
Lupine	*Lupinus* spp.
Meadow-Rue	*Thalictrum occidentale*
Miterwort	*Mitella stauropetala*
Orange Trumpet Flower	*Lonicera ciliosa*
Penstemon	*Penstemon* spp.
Phacelia	*Phacelia* spp.
Pyrolas	*Pyrola* spp.
Queencup Beadlily	*Clintonia uniflora*
Rattlesnake Plantain (Goodyear Orchid)	*Goodyera oblongifolia*

FORBS (continued)

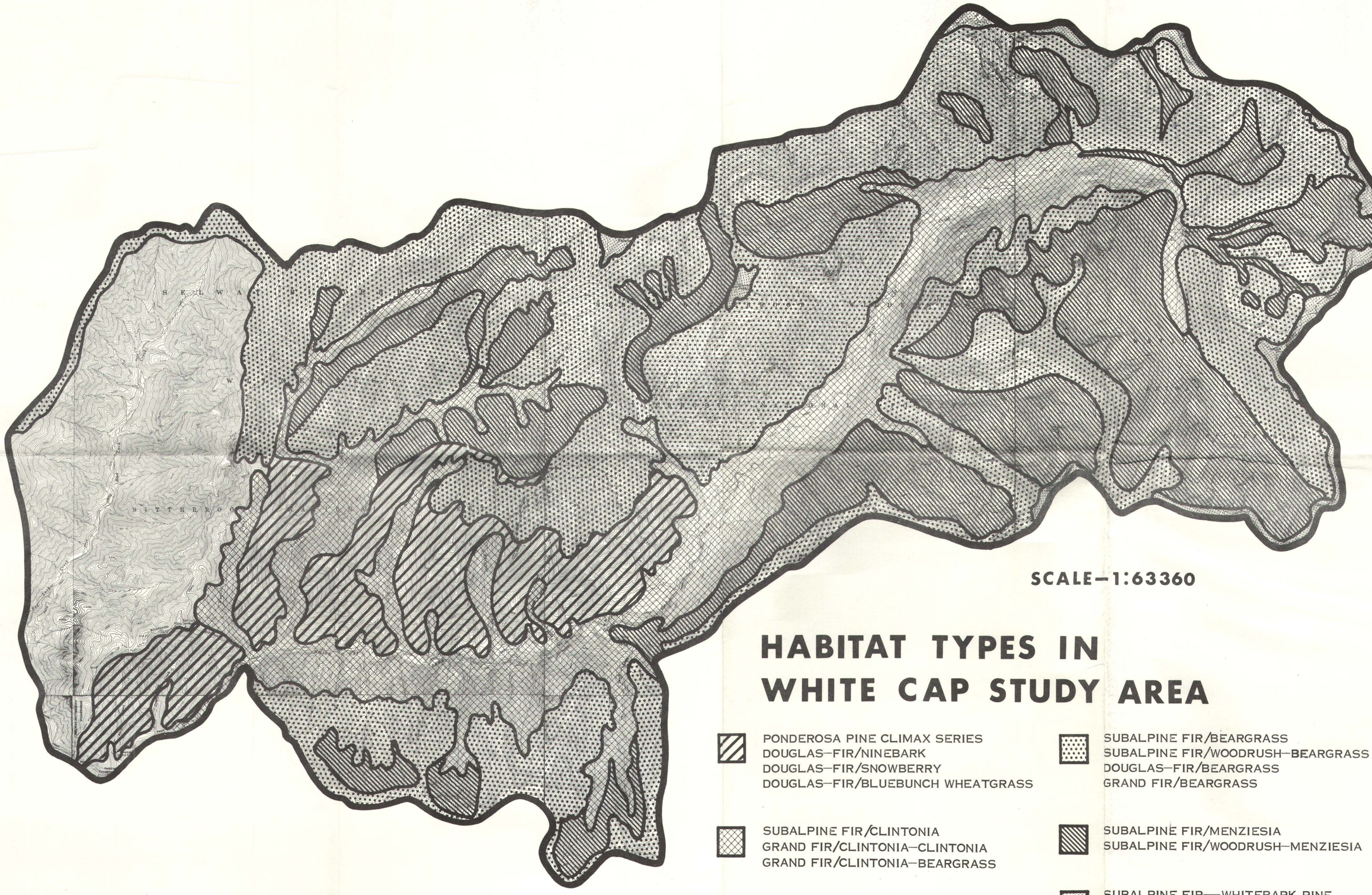
Common name	Scientific name
Rumex	Rumex acetosella
Sandwort	Arenaria macrophylla
Sedum	Sedum stenopetalum
Sego Lily	Calochortus spp.
Starry False Solomon's Seal	Smilacina stellata
Strawberry	Fragaria spp.
Trail Plant	Adenocaulon bicolor
Twinflower	Linnaea borealis
Twisted Stalk	Streptopus amplexifolius
Violet	Viola spp.
Virgin's Bower	Clematis hirsutissima
Wake-robin	Trillium ovatum
Wild Ginger	Asarum caudatum
Wild Hyacinth	Brodiaea douglasii
Wild Pea	Lathyrus spp.
Yarrow	Achillea millefolium

GRASSES AND SEDGES

Common name	Scientific name
Sedge	*Carex* spp.
Bluebunch Wheatgrass	*Agropyron spicatum*
Idaho Fescue	*Festuca idahoensis*
Cheatgrass	*Bromus tectorum*

TREES

Alpine Larch	*Larix lyallii*
Cedar	*Thuja plicata*
Cottonwood	*Populus trichocarpa*
Douglas-fir	*Pseudotsuga menziesii*
Engelmann Spruce	*Picea engelmannii*
Grand Fir	*Abies grandis*
Lodgepole Pine	*Pinus contorta*
Ponderosa Pine	*Pinus ponderosa*
Quaking Aspen	*Populus tremuloides*
Subalpine Fir	*Abies lasiocarpa*
Western Larch	*Larix occidentalis*
Western Yew	*Taxus brevifolia*
Whitebark Pine	*Pinus albicaulis*



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HABITAT TYPES IN WHITE CAP STUDY AREA

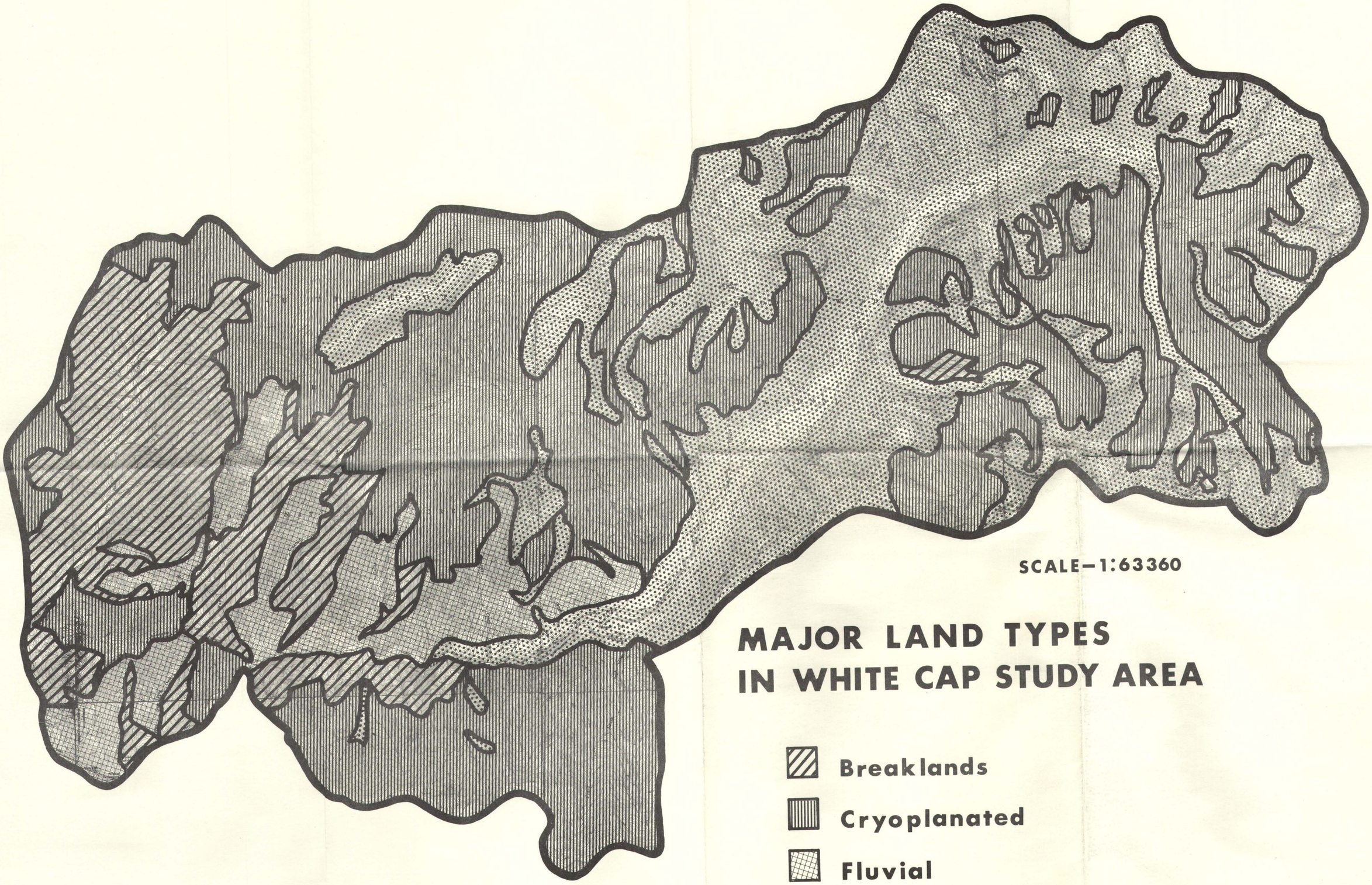
PONDEROSA PINE CLIMAX SERIES
DOUGLAS—FIR/NINEBARK
DOUGLAS—FIR/SNOWBERRY
DOUGLAS—FIR/BLUEBUNCH WHEATGRASS

SUBALPINE FIR/CLINTONIA
GRAND FIR/CLINTONIA—CLINTONIA
GRAND FIR/CLINTONIA—BEARGRASS

SUBALPINE FIR/BEARGRASS
SUBALPINE FIR/WOODRUSH—BEARGRASS
DOUGLAS—FIR/BEARGRASS
GRAND FIR/BEARGRASS

SUBALPINE FIR/MENZIESIA
SUBALPINE FIR/WOODRUSH—MENZIESIA

SUBALPINE FIR—WHITEBARK PINE
SUBALPINE FIR—ALPINE LARCH



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MAJOR LAND TYPES IN WHITE CAP STUDY AREA

- Breaklands
- Cryoplanated
- Fluvial
- Glaciated

SUB-ALPINE

SHRUBFIELD

PP/DF SOUTH SLOPE

PONDEROSA PINE SAVANNA

NORTH SLOPE COMMUNITIES

SELWAY-BITTERROOT WILDERNESS

BITTERROOT NATIONAL FOREST

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WHITE CAP FIRE MGT. ZONES AND PRE-ATTACK MAP

- Study Boundary
- Zone Boundaries
- Pre-Attack Lines
- 4500′ Contour (PP/DF)
-) (Passes with continuous fuels